The American Journal of Surgery

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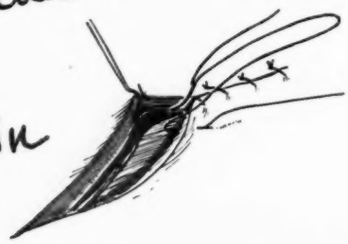


(b) Always handle cut skin edge with fine hook

2. Skin suture (fine silk or nylon) should pass through deep dermal layer.

3.

(a) Subcutaneous muscles of expression are sutured with fine catgut, inverted knot..

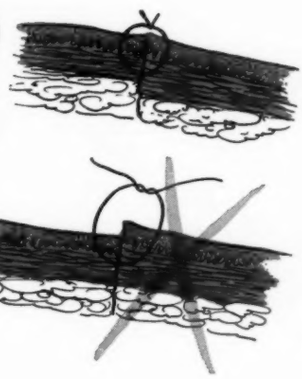
(b) Knot tied just beneath skin tends to be extruded

SUTUREGRAM

NUMBER SEVENTEEN (CONTINUED)

4(a)

(b)



When suturing skin of uneven thickness, suture should pass through both sides at same depth (a)

5. Avoid devitalization of skin angles by using intradermal sutures

6.

With lip, alar border or eyelid, first suture should restore continuity of margin

7. Use catgut for suturing mucous membranes and nasal lining.

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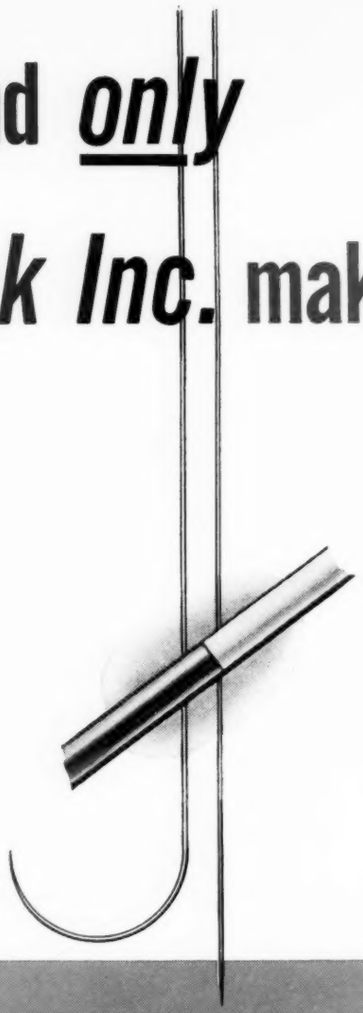

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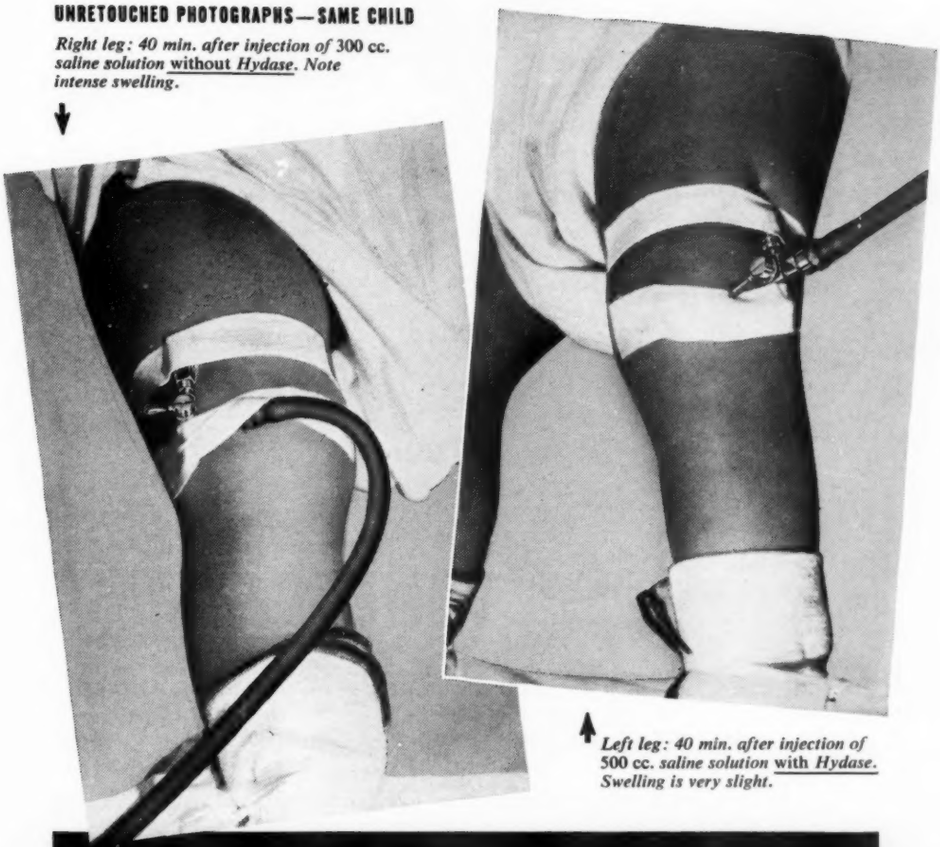

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SUPPURATIVE COMPLICATIONS OF THORACICO-ABDOMINAL WOUNDS . . *Joseph P. Lynch* 621

A review of fifty-six patients with suppurative complications of thoracico-abdominal wounds has been presented and the technic of radiopaque oil injections discussed. The combination of the operation of decortication of an infected hemothorax with subphrenic drainage of a liver abscess is described.

ARTERIAL BLOODLETTING DURING OPERATION AS AID IN HEMOSTASIS . . . . . *W. James Gardner and Donald E. Hale* 635

The authors' thesis is that arterial bloodletting during operation is an aid in hemostasis. The procedure is followed by the intra-arterial injection of the removed blood at the end of operation. Illustrative case reports are presented.

ADDISON'S DISEASE AND PREGNANCY . . . . . *Florence Brent* 645

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CHORIO-EPITHELIOMATOUS ELEMENTS OCCURRING IN TERATOMA OF THE TESTIS . . . *Cary P. Gray, John R. McDonald and Gershom J. Thompson* 653

Chorio-epitheliomatous elements do occur in malignant teratomas of the testis; their greatest incidence is in the third decade (also in the fourth decade in large numbers). The hormone assay should be done before operation and the type of hormone should be determined if the assay is to be of value in the prognosis.

EARLY CARE OF THE TRAUMATIZED HAND WITH PEDUNCULATED FLAPS *G. Kenneth Lewis* 660

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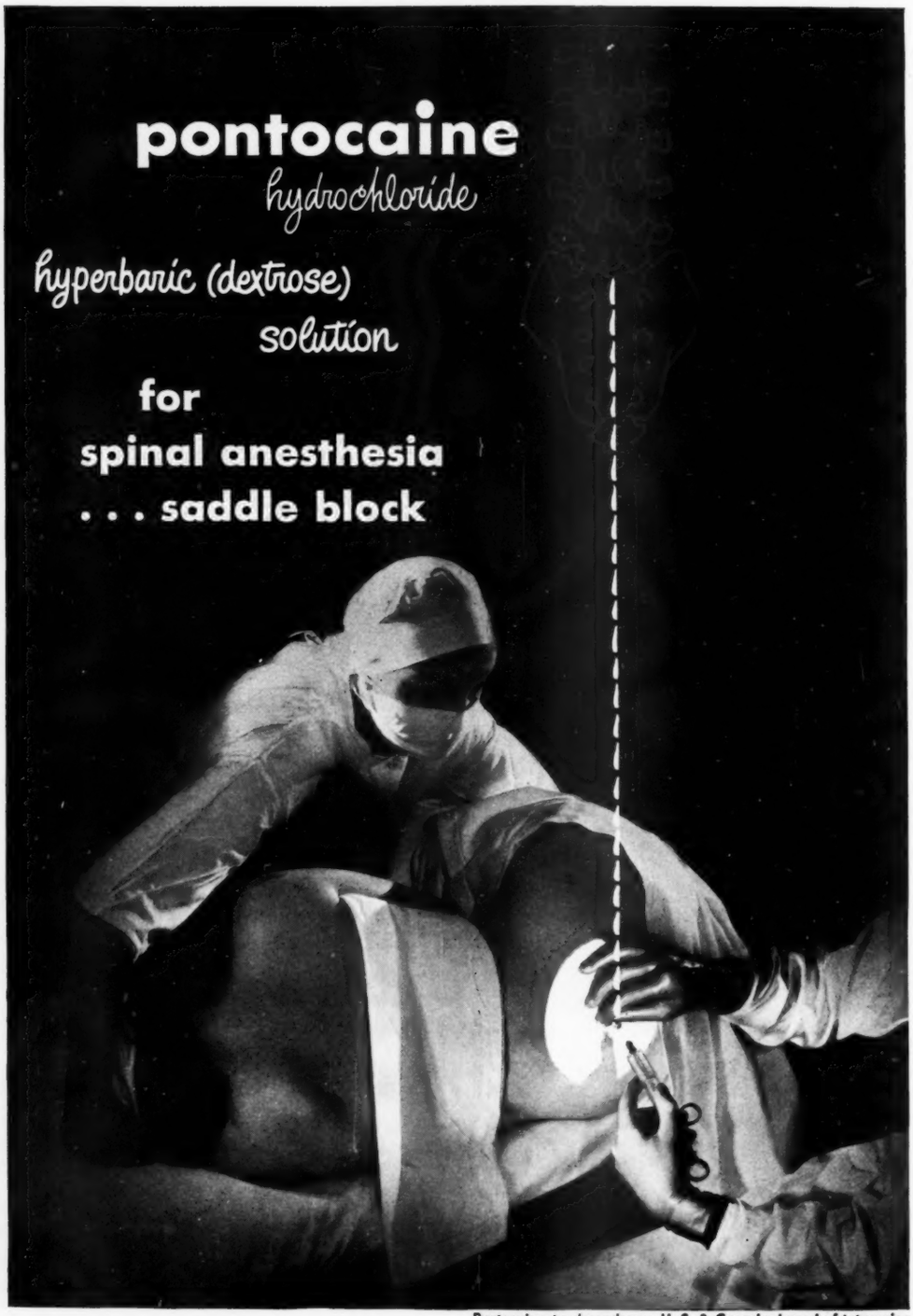

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CAUSES AND METHODS OF REPAIR OF DIRECT AND RECURRING INGUINAL HERNIAS . . . *Jackson K. Holloway and Robert J. Johnson* 678

After enumerating the causes and methods of repair of direct and recurring inguinal hernia a technic for accomplishing satisfactory results is given in detail.

PHYSIOLOGIC EFFECT OF MASSIVE SMALL INTESTINAL RESECTION AND COLECTOMY . . . *J. E. McClenahan and Bernard Fisher* 684

Nature's ability to compensate for tissue removal is demonstrated in massive removal of portions of the intestinal tract. Two cases in which rather detailed study was done following resection of all but 38 inches of the small bowel and a subtotal colectomy are presented with conclusions.

ANALYSIS OF THE MECHANICAL PRINCIPLES AS APPLIED IN TRACTION OF FRACTURES OF THE FEMUR . . . . . *E. H. Weissenberg and W. Swienty* 689

In fracture of the femur two methods of traction are mechanically analyzed; gravity acts against the pulling force in one method but with the pulling force in the other. For this technic of traction new special apparatuses are suggested.

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The clinical features of sixteen cases of cutaneous malignant melanomas are presented. Only two patients lived four and a half years after treatment. The present status of malignant melanomas is reviewed.

PERIANAL INFECTION IN THE TUBERCULOUS PATIENT. SURGICAL NOTES . *Julius Gerendasy* 701

A plea for the surgical treatment of anorectal conditions in tuberculous patients. Two hundred four consecutive patients with anorectal complaints were studied. The physical examination and types of lesions are discussed.

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ORTHOPEDIC SURGERY ON PARAPLEGIC PATIENTS . . . . . *Philip L. Staub* 717

Orthopedic surgery can be undertaken with safety on paraplegic patients. The author reviews twenty-one orthopedic procedures on fourteen paraplegic patients.

FEMORAL VENIPUNCTURE . . *Donald T. Bosch, John P. Kengeter and C. Abbott Beling* 722

The technic of venipuncture is described. The ability to perform a venipuncture is a practical asset to any physician.

CARCINOMA OF THE BREAST . *C. Douglas Sawyer, Edwin T. Long and Richard A. Gilman* 725

A critical study of carcinoma of the breast in 165 patients treated primarily with surgery. In 112 of these a five-year follow-up was obtained.

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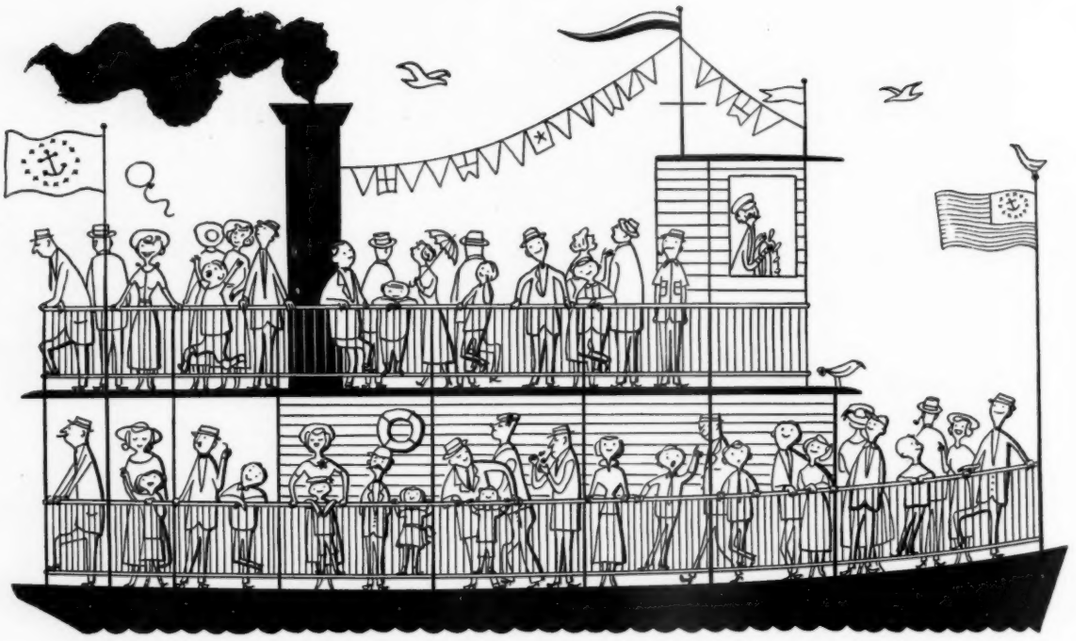

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EVALUATION OF RESULTS FROM CERVICAL DISC SURGERY . . . . *Walter G. Haynes* 730

An evaluation of cervical disc surgery is made. Thirty-three cases of surgically treated cervical discs are analyzed.

BURNS—A SURGICAL PROBLEM . . . . . *John R. Green* 733

A method of treatment is described, developed over a ten-year period, using the concept of a burn as an open wound subject to infection, contraction deformities and delayed healing.

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SYNDROME FOLLOWING GASTROILEOSTOMY . . *Kenneth B. Castleton and Fuller B. Bailey* 736

Report of a case in which an anastomosis of the ileum to the stomach was done in the belief that the jejunum was being anastomosed (one of the rarest surgical errors). The literature reveals only twenty-six previously reported cases.

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A report of a patient with perineal lipoma which simulated a posterior perineal hernia of the ischiorectal type, with description of findings, differential diagnosis and operation.

ANTERIOR SACRAL MENINGOCELE . . . . . *Robert M. Sherman, Harold D. Caylor and Leonard Long* 743

Three cases of anterior sacral meningocele are reported (thirty-one cases have been reported previously). The lesion manifests itself as a palpable and cystic tumor mass between the rectum and sacrum and represents a herniation of the meninges through a defect in the anterior plate of the sacrum.

TRAUMATIC ASPHYXIA. . . . . *Max E. Dodds* 748

A presentation of a case of traumatic asphyxia showing that if death does not take place within a short period following the trauma, prognosis for complete recovery is good.

New Instrument

NEW TYPE OF T TUBE . . . . . *Howard B. Miller* 750

Advertising Index on 3rd Cover

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SUBVITAMINOSIS "B" RESULTING FROM PROLONGED PARENTERAL FEEDING OF DEXTROSE HAS LONG BEEN RECOGNIZED[1,2,3] **1.** SYDENSTRICKER, V. P.: The Clinical Manifestations of Nicotinic Acid and Riboflavin Deficiency (Pellagra), Ann. Int. Med., 14:1499 (March) 1941. **2.** POLLACK, H., ELLENBURG, M., and DOLGER, H.: Postoperative Precipitation of Vitamin B Complex Deficiencies, J. Mt. Sinai Hosp., 8:925 (Jan.- Feb.) 1942. **3.** INGELFINGER, F. J.: Parenteral Use of Vitamin Preparations, New Eng. J. of Med., 233:379-85 and 409-17, 1945.

IN RECENT YEARS, THE ESSENTIAL ROLE OF VITAMINS IN COMPLETE PARENTERAL FEEDING HAS BEEN NOTED[4,5,6] **4.** RICE, C. O., *et al.*: Parenteral Nutrition, Pre- and Postoperative Use of Glucose, Amino Acids and Alcohol (A Preliminary Study), Journal-Lancet, 68:91 (March) 1948. **5.** GOLDSMITH, G. A.: Importance of Vitamins of the B Complex in Clinical Medicine, So. Med. J., 39:485-94 (June) 1946. **6.** Stigmas suggesting various gross vitamin deficiencies and the recommended treatment as provided by the Council on Foods and Nutrition, J.A.M.A., 131:666-7, 1946.

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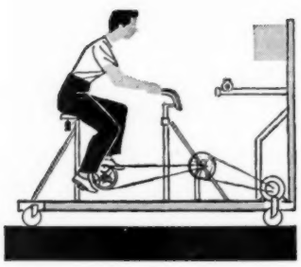

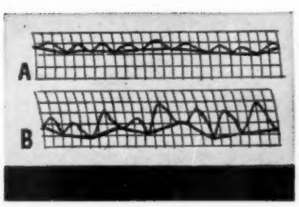

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Hewitt, W. L., and Williams, B., Jr.: New England J. Med. *242*:119, 1950

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Payne, E. H.; Knaudt, J. A., and Palacios, S.: J. Trop. Med. & Hyg. *51*:68, 1948

"NO symptoms or signs of toxic effects attributable to the drug were observed."

Ley, H. L., Jr.; Smadel, J. E., and Crocker, T.: Proc. Soc. Exper. Biol. & Med. *68*:9, 1948

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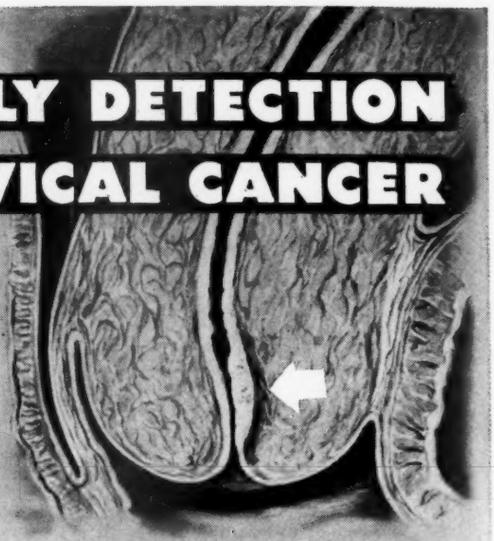

An important new Biopsy Technique

Designed by Saul B. Gusberg, M. D., of Columbia's College of Physicians and Surgeons—this new, amazingly simple instrument marks a significant step forward in the diagnosis of early cervical neoplasms. With the Gusberg curette... precision-built by J. Sklar Manufacturing Company of finest-quality, American-made stainless steel...a coning biopsy of the entire squamous-columnar junction may be quickly accomplished in one painless, easily performed, office procedure. No anesthesia or other special equipment required. Invaluable for tissue confirmation with the vaginal smear technique, or as a primary scouting method. Other Sklar Stainless Steel Instruments are also available for endometrial biopsies, etc. Reprints and descriptive literature forwarded on request.

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PATENT PENDING

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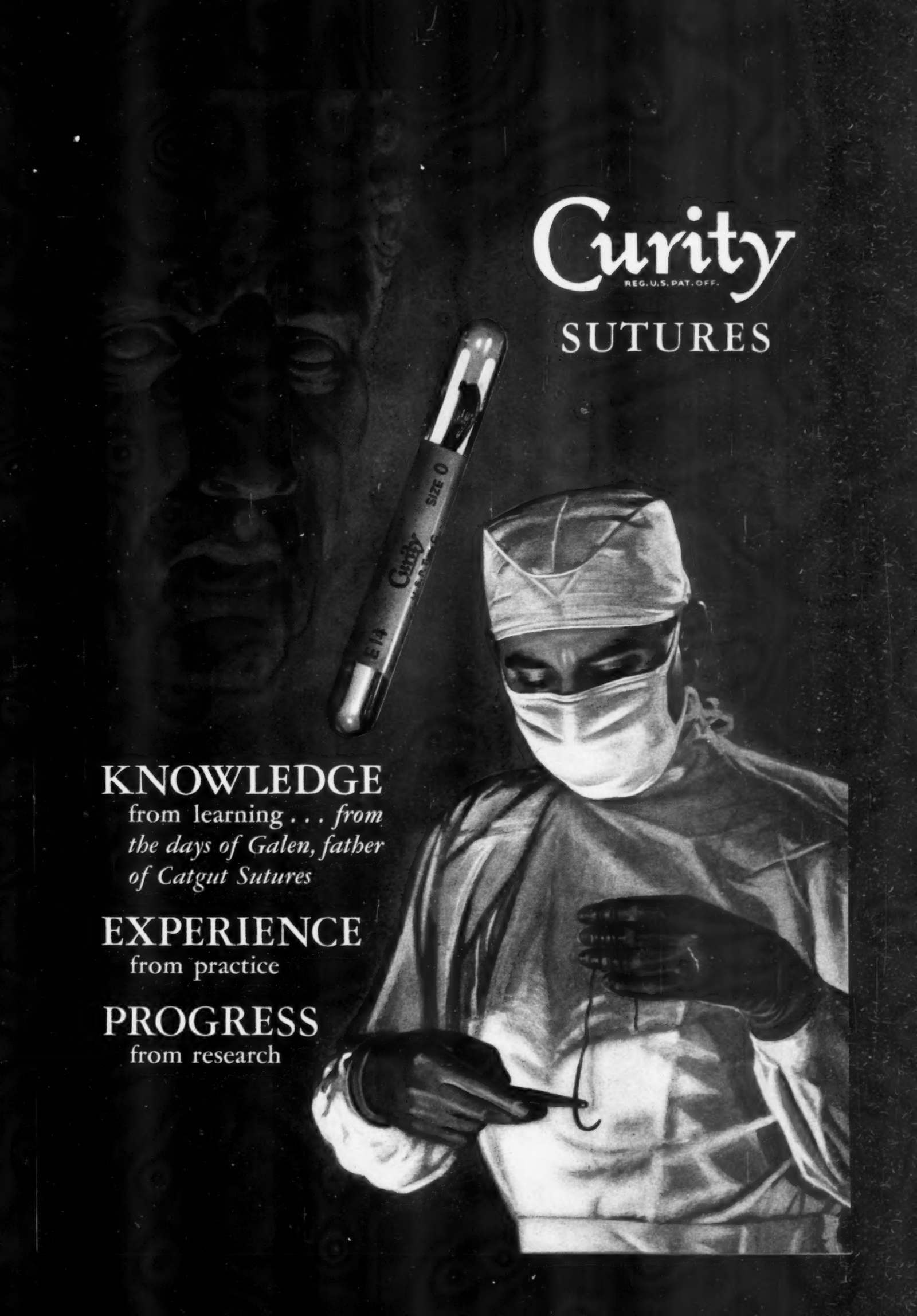
This Name Marks the Genuine Instrument

Made in three sizes—
SMALL · MEDIUM · LARGE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SIZE 0
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from learning . . . *from the days of Galen, father of Catgut Sutures*
EXPERIENCE
from practice
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from research

Curity CATGUT

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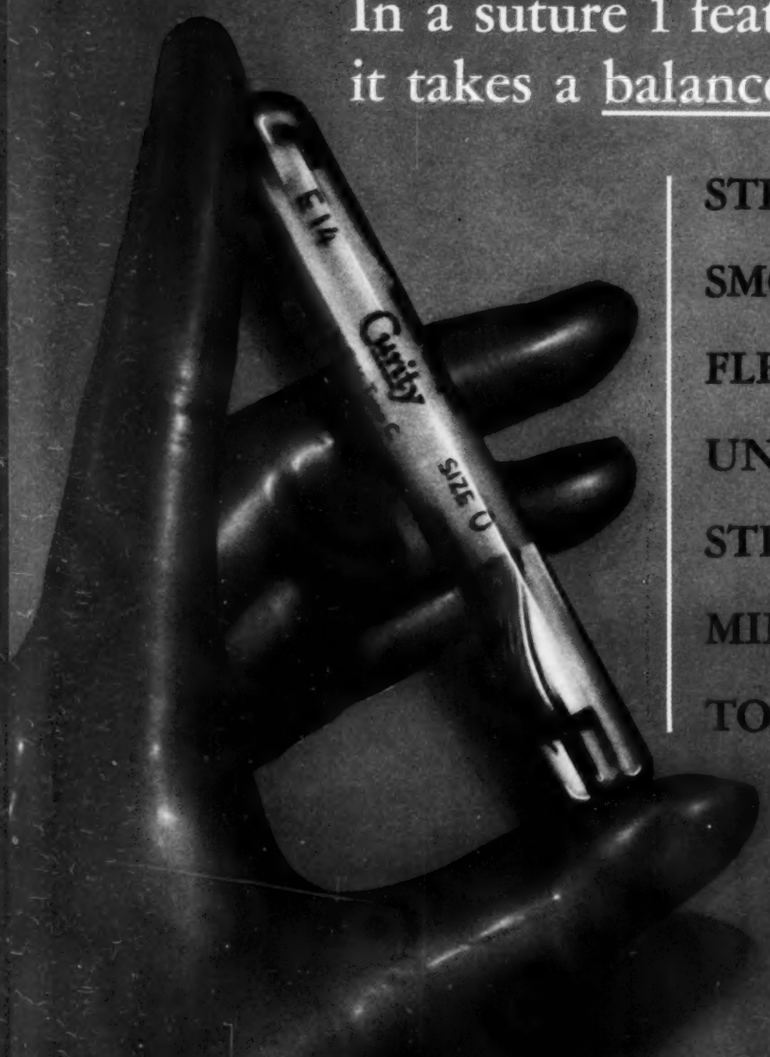
In a suture 1 feature is not enough,
it takes a balance of 7–



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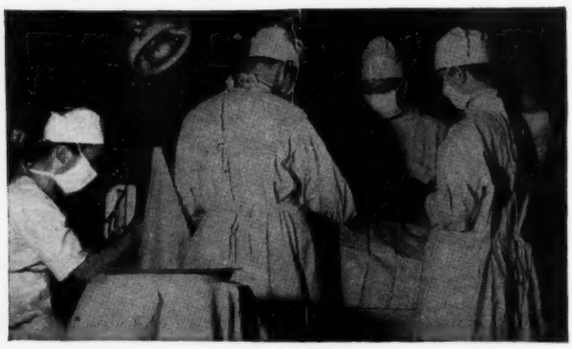

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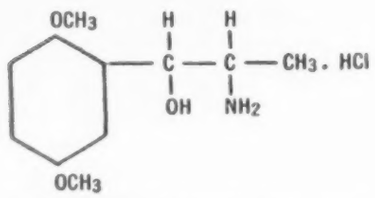

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During cyclopropane anesthesia Stutzman et al.[2] find 'Vasoxyl' a "safe pressor agent."

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1. *Baltzly, R., and Buck, J. S.: J. Am. Chem. Soc. 64:3040, 1942.*
2. *Stutzman, J.: J. Pharm. & Exptl. Ther. 97:385, Dec., 1949.*
3. *Hjort, A. M.; Randall, L. O., and de Beer, E. J.: J. Pharm. & Exptl. Ther. 92:283, 1948; de Beer, E. J., and Dews, P. B.: To be published.*
4. *King, B. D., and Dripps, R. D.: To be published.*
5. *Kistler and Ruben: To be published.*

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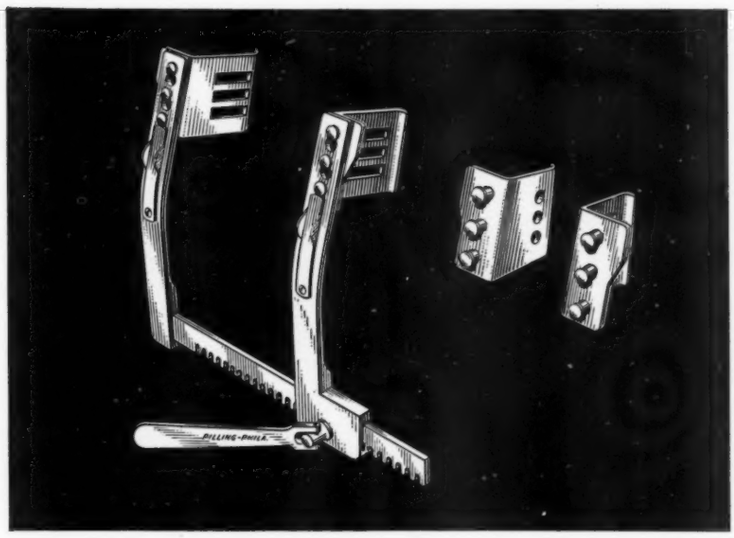

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Outside the Ivory Tower

THE American Physicians Art Association will have its twelfth art exhibition in conjunction with the American Medical Association Convention at San Francisco Auditorium June 26 to 30, 1950. Any physician who follows the hobby of fine or applied arts can exhibit at this convention by becoming a member of the A.P.A.A. and applying for entry blanks and shipping labels of the secretary, F. H. Redwill, M.D., 526 Flood Bldg., San Francisco, 2, California.

ETHICON SUTURES (Johnson & Johnson) sent us a box of Gamophen Antiseptic Soap for personal use. We are busy on the first cake. We are told it is emollient, rich-lathering, fast-acting, continuously effective and economical. Gamophen contains hexachlorophene (2 per cent), the most effective, longest acting skin antiseptic known. Gamophen has been tested in three and a half years of laboratory and clinical evaluation. Some investigators claim that the standard scrub of fifteen or twenty minutes may safely be reduced to from three to six minutes when this soap is used. Gamophen is supplied in 4½ ounce bars for home and office, in 2 ounce bars for hospital personnel and patients' use. It is especially recommended (outside of hospital personnel) for preoperative antisepsis of the skin and in industrial clinics and first aid stations. We are using it in our office.

JOHN Gunther, author and foreign correspondent, has turned over $4,937 from royalties on his book "Death Be Not Proud" to Columbia University for research in neurologic surgery for children. The announcement was made by Dr. Willard C. Rappleye, dean of the University's Faculty of Medicine, who at the same time disclosed that the publishers of the book, Harper and Brothers, have also contributed $825 in earnings toward the research project.

The Gunther fund, to be known as the "John Gunther, Jr. Memorial Gift," has been established in the Department of Neurological Surgery at Columbia. John Gunther, Jr., subject of "Death Be Not Proud," was treated at the Neurological Institute at the Columbia-Presbyterian Medical Center before his death in June, 1947.

MORE than a half billion dollars' worth of hospital and health center construction has been approved for government aid in the past twenty-five months, Federal Security Administrator Oscar R. Ewing announced. In addition to federal funds this sum includes funds provided by the states, local communities and private organizations.

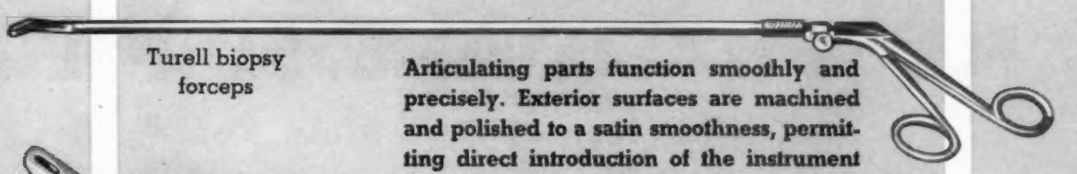
Projects cleared by the Public Health Service over this period totaled 1,019 hospitals and health centers. They received a total of $210 million in federal funds. The first hospital approved for federal aid under the National Hospital Program was at Langdale, Alabama, in November, 1948. At present 139 are in operation, 523 under construction and 357 approved initially but still in the blueprint stage.

THE average length of life in the United States has increased to 67.2 years. This was based on a compilation of 1948 mortality statistics completed by the National Office of Vital Statistics, Public Health Service.

(*continued on page* 30)

A.C.M.I. Forceps

Precision of design and construction, with meticulous attention to detail and uncompromising excellence of workmanship distinguish these A.C.M.I. Forceps, made in our own plants by American craftsmen from American materials. Each forceps possesses the inherent strength and durability characteristic of A.C.M.I. instruments.

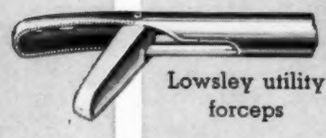


Turell biopsy forceps

Articulating parts function smoothly and precisely. Exterior surfaces are machined and polished to a satin smoothness, permitting direct introduction of the instrument (as indicated) without resort to a sheath.

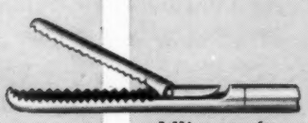
WRITE FOR LITERATURE DESCRIPTIVE OF THE MANY OTHER TYPE FORCEPS.

Yeomans rectal biopsy forceps

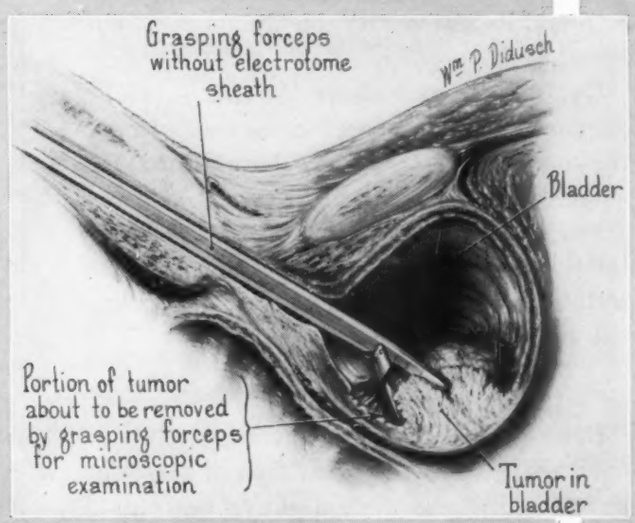


Lowsley utility forceps

A.C.M.I. cervical & rectal punch



Alligator forceps


Grasping forceps without electrotome sheath
Wm P. Didusch
Bladder
Portion of tumor about to be removed by grasping forceps for microscopic examination
Tumor in bladder

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Hexachlorophene exerts a prolonged antibacterial effect against resident flora of the skin, gram-positive and gram-negative organisms, pathogenic and non-pathogenic bacteria.

Several investigators have found that the standard scrub of 15 or 20 minutes may safely be reduced to from 3 to 6 minutes when Gamophen is used.

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*"Hexachlorophene" has been accepted by the Council on Pharmacy and Chemistry of the American Medical Association as the generic term for dihydroxyhexachlorodiphenyl methane.

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S. hemolyticus and E. Coli, and 10% greater against Cl. welchii, than 3½% tincture iodine.

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In other tests, hexachlorophene in Gamophen was found to be more effective than it was in other vehicles, such as certain liquids having an acid pH, in which it is bacteriostatic but not bactericidal. Liquid solutions having an acid pH lower the effectiveness of hexachlorophene.

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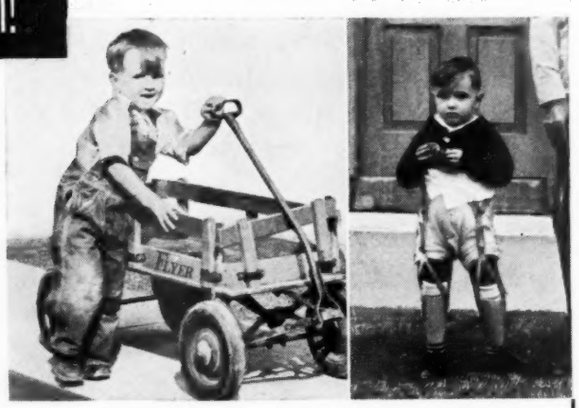

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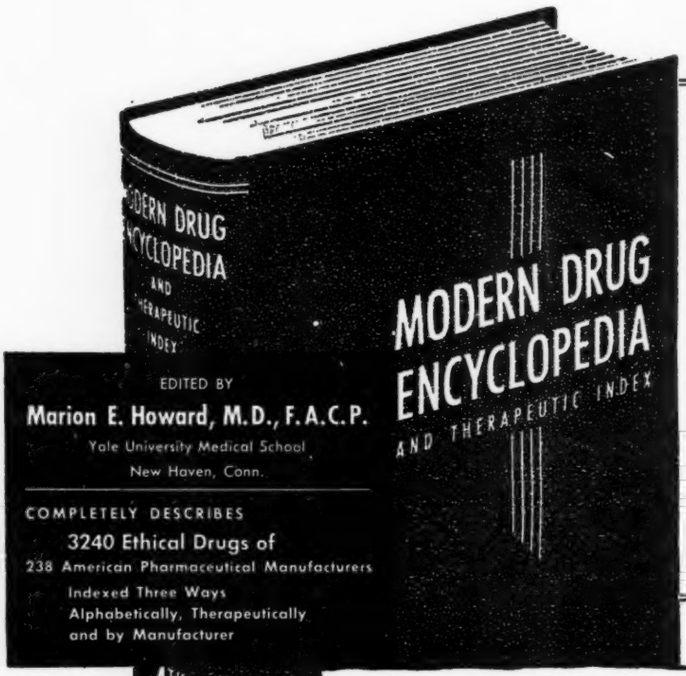

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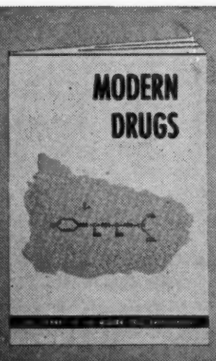

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E. coli	15 min.	3 min.
Strept. hemolyticus	15 min.	15 sec.

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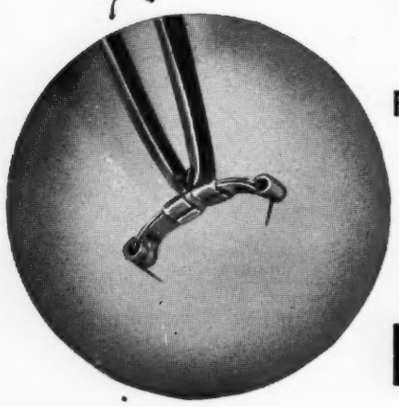
The Ants of the Amazon . . .

forerunners of the modern wound clip



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CALCIUM	1.12 Gm.	NIACIN	6.8 mg.
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IRON	12 mg.	VITAMIN D	417 I.U.
COPPER	0.5 mg.	CALORIES	676

*Based on average reported values for milk.

Two kinds, Plain and Chocolate Flavored. Serving for serving, they are virtually identical in nutritional content.

Outside the Ivory Tower

(*continued from page 20*)

PREDICTION by a group of scientists and health experts that a much larger quantity of ACTH, cortisone and similar hormonal compounds would be produced this year was made public by Federal Security Administrator Oscar R. Ewing. The hormonal drugs, now extremely scarce, were reported last year to offer for the first time definite hope of an effective treatment for arthritis, rheumatic heart disease, certain forms of cancer and mental disease, and for certain other disease conditions.

AMERICA'S 7,000,000 arthritis victims must look to the chemist to provide, by synthetic means, an unlimited supply of cortisone to combat the crippling disease, Dr. Edward C. Kendall of the Mayo Clinic, Rochester, Minnesota, co-discoverer of the compound, told the Chicago Section of the American Chemical Society.

No known natural source can meet the enormous demand for the scarce hormone, Dr. Kendall indicated, although compounds derived from certain Mexican plants "hold promise of a large potential source for cortisone, and doubtless will provide the material in the not distant future."

Many months, and perhaps years, will be needed to find out how to prepare cortisone by total synthesis, starting with simple chemicals found in the laboratory, even though many researchers already are working on the problem.

MORE than three-quarters of a billion dollars was paid by the Metropolitan Life Insurance Company during 1949 to living policyholders or beneficiaries. The total, $768,627,888, was the largest in the company's eighty-two-year history and the year was the eighteenth in succession in which such payments exceeded the half billion dollar mark.

The 1949 total included $267,000,000 in death claim payments, $160,000,000 in matured endowments and annuity payments, and nearly $70,000,000 in disability, accident and health, and surgical, hospital and medical expense benefits.

TWO decades of progress in overcoming the hazards of pregnancy and childbirth have reduced the death toll from maternity in the United States to one-seventh of its former rate.

The maternal mortality rate of twenty years ago was seven per 1,000 live births, one of the highest in the civilized world at that time. The rate was down to 1.3 per 1,000 by 1947, the latest year for which complete data are available, and currently it is estimated to be about 1 per 1,000 live births.

Our country is now in the vanguard of nations with respect to safeguarding maternity.

The population of the United States at the mid-century mark, well over 150,000,000, is just about double what it was at the beginning of the century. Thus, the numerical gain in the nation's population in the last fifty years has been as great as in nearly 300 years between the Colonial settlements and 1900.

FOR the second time in its history the Directors of the Passano Foundation announce a dual award, the $5,000 cash award for 1950, going to Dr. Edward C. Kendall and Dr. Philip S. Hench both of the Mayo Clinic, Rochester, Minnesota, for their studies in clinical physiology as related to the administration of cortisone and related hormones. The award will be presented at the annual award dinner to be held this year at the St. Francis Hotel in San Francisco on June 28th. This is the week of the annual meeting of the American Medical Association there and Dr. Elmer L. Henderson of Louisville, Kentucky, President-elect of the American Medical Association, will make one of the principal addresses. Officers and Trustees of the Association will be guests.

THE expectation of life at birth among American wage-earners and their families reached an all-time high of 67.8 years in 1949, an increase of about .6 of a year from 1948, according to the statisticians of the Metropolitan Life Insurance Company. It was the sixth year in succession to show a gain.

(*continued on page 37*)

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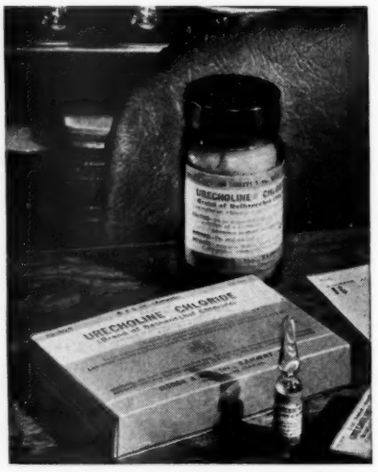

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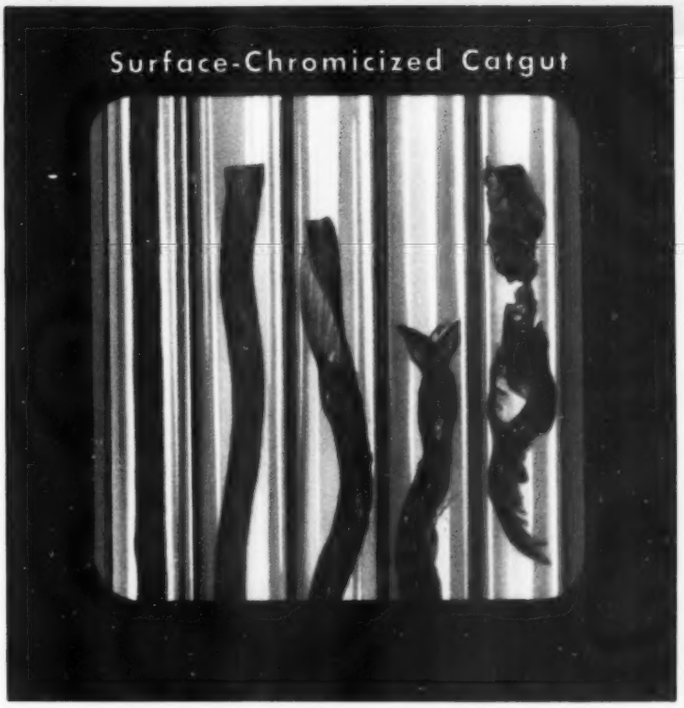

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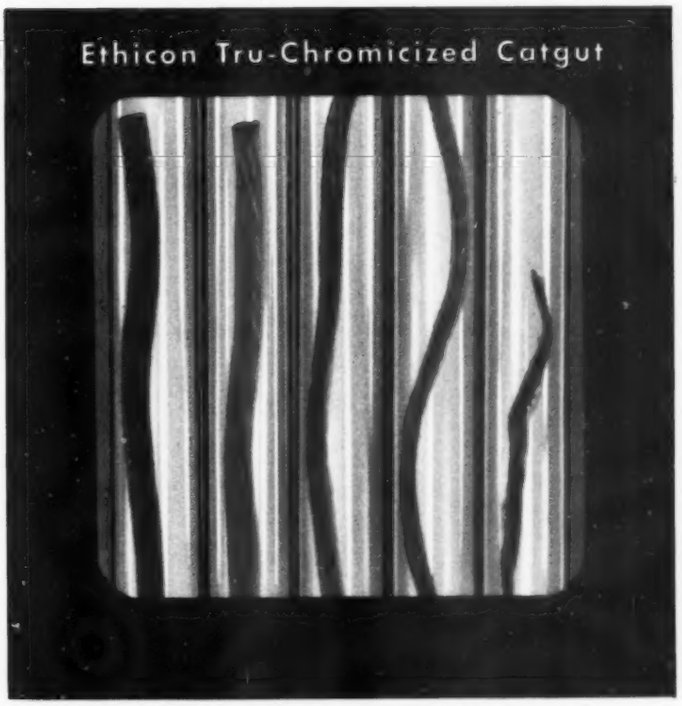

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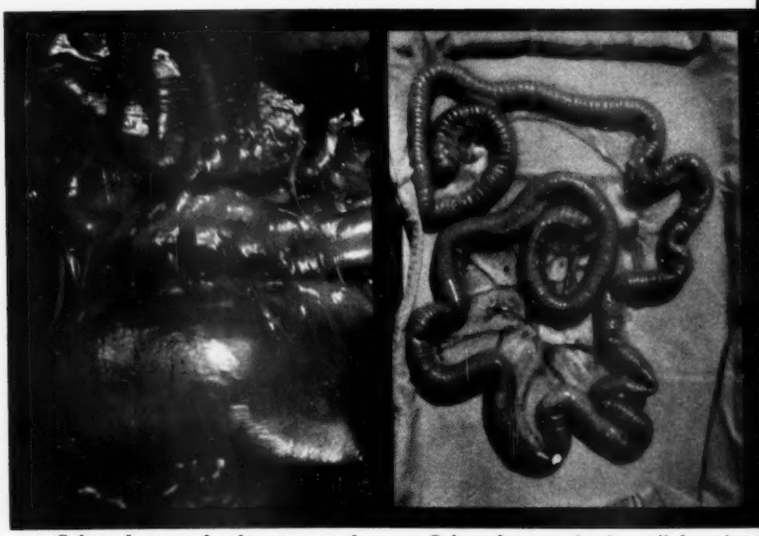

Color photograph of a group of adhesions showing the agglutinated talc masses appearing as white flecks within the adhesions.

Color photograph of small bowel of a dog treated with Bio-Sorb Powder. Note complete absence of adhesions or demonstrable inflammatory reaction.

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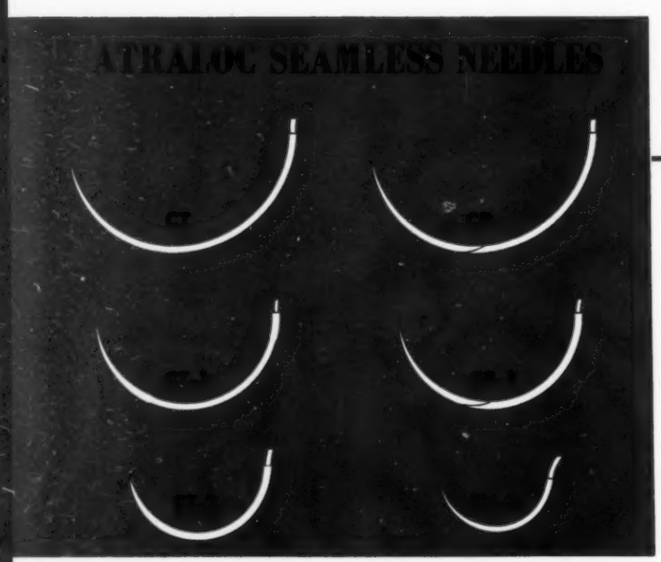

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Editorial

INFECTION AND LEAKAGE COMPLICATING ABDOMINAL SURGERY

MORTALITY and morbidity in abdominal surgery have decreased rapidly in the past three decades even though much more surgery is done and new fields of intra-abdominal pathology have been invaded by the surgeon. The mortality at present has reached a new low, but in spite of this in any general hospital we will still find deaths, many of which are preventable.

In this article the problem of how to reduce the reduced mortality due to infection and visceral leakage will be discussed. First, I want to call the reader's attention to the one unfortunate trait of man, especially in the scientific field, of "diving in" to any new panacea that looks like a "cure all," and neglecting or omiting tried and proven practices that have withstood the test of time and experience. If we review the literature, we will find a large number of surgeons embracing some new method and attempting to make it do the impossible. Such actions can only produce one result—increased mortality and morbidity. Surgeons of all times have recognized that any undesirable fluid in the abdomen is a danger and a menace to the patient and have endeavored with every means at their command to remove it. The attempt was made by what is called drainage but should always have been termed venting. How the term drainage ever came to be applied to abdominal surgery I am unable to determine, but it should not have been. The doctor forgot to ask his lay friends what drain means. It means to empty, take out or withdraw by gravity if down hill, or by other active means (suction) if up hill. That brings us to the point that over the years, the profession as a whole *did not* drain any field but continued to call it by the incorrect term. In looking over current journals I find the word still prominent, for example, this or that was drained but the patient died. How much better it would be if we would say that we left the incision open and placed a wick so the fluid could overflow when the abdomen or reservoir became well filled. That is what is done and what has always been done. This is the reason that the records show altogether too high mortality and morbidity rates. If any surgeon or operator after reading the foregoing remarks continues to substitute the word drain for wick or vent in surgical literature or conversation, he may be considered to be grossly guilty of ignorance of the meaning of the word, is misrepresenting the type of treatment applied and is depriving the patient of the most valuable of all weapons in combating infection and leakage in the abdominal cavity. However, the only criticism di-

rected against the surgeon is his misuse of the word. It has not stimulated constructive thinking to do something about drainage. That venting left much to be desired is admitted by all, but the removal of undesirable fluid was the one great wish

recognized that fluid will not run uphill, went so far as to turn patients on their abdomens so the fluid could actually run out, just as anyone would do if they wanted to empty a bottle. The result was a great improvement and the lives

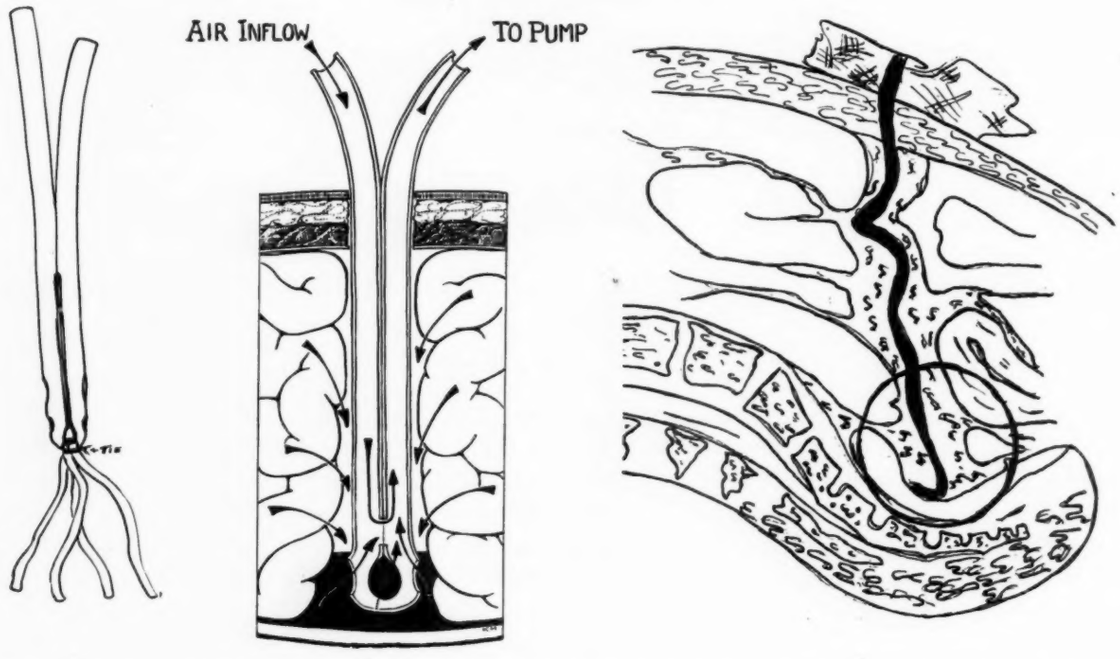

FIG. 1. New type of tube now in use; shows Penrose tails attached which direct fluid to low point to be sucked out. This type of tube drains a wide area of infection and increases effectiveness of the Chaffin tube in suction drainage.
FIG. 2. Graphic illustration of a Chaffin tube in the abdomen surrounded by loops of intestine. It is approximately 8 inches long with an inside diameter about $\frac{5}{16}$ inch. Large arrows show direction of peritoneal secretion by gravity to lowest point—bottom of well. Small arrows show fluid entering tube to be aspirated by the pump. Air flows in freely in open limb, through by-pass and out other limb, as shown. There is no suction on eyelets.
FIG. 3. Illustrates what a Penrose wick will *not* do in any abdominal cavity; shaded area is collection of pus and serum flowing in every direction except straight up. When the area is completely filled, a small portion will overflow on the gauze. The area of infected tissue is increased manyfold. This new infected area accounts for most postoperative temperature and sepsis. A suction tube in this cavity prevents new infection and removes all secretion from the bottom.

of every operator. How could it be done? Dr. Poole devised a method of quickly removing all kinds of fluids from a cavity easily and quickly in the operating room. Older writers, Yates, Gaffey and others, found methods of directing pus and serum to a natural reservoir and stated, "If we could remove this as rapidly as peritoneal secretion forms it, we believe that few patients need die of the complications of abdominal surgical diseases."

One small group of men who did understand that drain means to empty and

of many patients with peritonitis were saved. Williams, Rankin, Lossen and others tried this method. The bad feature of that treatment was that all infections passed over clean viscera in their exit and, in addition, the wound became badly infected. That in itself sometimes caused deaths.

The author began removing fluid by suction forty years ago, and more recently Babcock and McCrea continued the Poole operating room technic at the bedside. These methods of real drainage (not wicks

and vents) immediately reduced mortality about 90 per cent and morbidity even more. The author has found, by a rather wide personal experience and by the accumulated experiences of scores of other surgeons, that drainage will protect the patient to the utmost from spreading infection or visceral leakage. Spreading peritonitis occurring after the doctor has seen the patient is a doctor-made disease; he has not drained early enough. The infection started at a point by inflammation or leakage. Since the surgeon could not and would not remove it, how could it be expected in most instances to do other than spread? It did because of the laws of physics that apply to fluids and cause infection to flow laterally and not vertically (uphill) even when vented. (Figs. 1 to 3.)

We relieved (streptococci) pelvic infection due to abortion promptly, with early recovery. Pelvic abscesses were drained per abdomen early; there was no waiting weeks or months for bulging or rupture of the cul-de-sac and finally death. Operations were performed for appendicitis at any stage, with prompt relief from infection. (How could anyone expect a wick to influence favorably a pelvis filled with colon pus?) We have done primary anastomosis in all surgery of the large bowel for the past twenty years. We had a few leaks but always into the collector bottle, not an abscess with peritonitis. Surgery for cholecystic disease is always protected against bile peritonitis. Ruptured ulcer on the second or third day recovers with drainage. Bladder rupture with extravasation and suprapubic prostate surgery is made entirely safe with suction drainage and, furthermore, the patient is *kept dry*. Retropubic prostatic surgery if protected with a special Chaffin tube will prevent all of the occasional serious complications of infection. Liver abscess is safely handled by suction drainage. Duodenal stumps in resections are always protected. Subdiaphragmatic abscess does not occur; it is due to lack of drainage or wicks. These are only a few of the fields of abdominal surgery that are so easily and safely protected from the complications of infection and leakage.

The results of suction drainage in preventing and curing peritonitis before the advent of polychemistry and later antibiotics compared very favorably with those of the present. We saw by statistical study the death rate go up during the sulfa days because the surgeons stopped thinking about the undesirable fluid (again neglecting the use of proven practices and going "all out" for a new panacea) and *en masse* began wishful thinking. They placed their hope in the new miracle drug, closed up the incision, which compelled the infection to remain inside, wishfully thinking that the patient could sterilize it. Statistics have given the answer to that method. Penicillin is now going through the same stage but with somewhat better results; there is still much to be desired, however.

How will antibiotics influence leaking bile, gastric juice, urine or fecal matter? Most patients with pancreatitis (nine personal cases) get well promptly if enzymes are washed out and three or four Chaffin tubes are placed in the several reservoirs and lesser cavity; this means a greatly lowered mortality. Duodenal and bile fistulas persist only a few days if suction-drained from their source. There is no digesting of the sinus and skin. Ask yourself, "Why do I permit pus to remain in the abdomen and try to compel the patient to sterilize it within his own organism? Is it desirable fluid and does it help the patient? Why should I not remove it and then help him with the remaining infection?" I with many others can think of only one answer: Suction drain every area where there is a remote possibility of infection occurring or where present. Do double, triple or even quadruple draining; then give medical treatment. This is the method to reduce mortality and morbidity rates.

To summarize: Water (pus) will not run uphill unaided. Pus and secretion flows laterally (seeks its own level). Any collection

of fluid has hydrostatic pressure at its base and periphery and its walls made of living tissue, with capillaries and lymph spaces promoting continuous absorption. Peritoneal secretion is nature's offense if the doctor will remove the excess and permit no pressure. Gravity drainage is now available if the surgeon will place a Chaffin tube (usually with tails) at the lowest point at which the fluid accumulates. Suction removes it as rapidly as it gravitates to this point.

RAFE C. CHAFFIN, M.D.

Acknowledgment: Figures 1 to 3 on page 618 were reproduced by the kind permission of *The Journal of the International College of Surgeons*. These illustrations originally appeared in that journal in an article entitled "Suction Drainage Era in Surgery" by Rafe C. Chaffin, pages 649 to 658, 1948.

Original Articles

SUPPURATIVE COMPLICATIONS OF THORACICO-ABDOMINAL WOUNDS*

JOSEPH P. LYNCH, M.D.
Brookline, Massachusetts

THE thoracico-abdominal wound presents to the surgeon one of the most complicated of all the varied wounds of warfare; the increasing success of the treatment of patients so wounded is attested by many recent reports on this condition.[1,2] The late complications, however, have received little attention in these communications although these wounds are subject to many mechanical and suppurative complications. The purpose of this report is to review a group of patients with such complications who were treated at a thoracic surgical center in the United Kingdom.[3]

The nature of the center was such that only patients with some complication of their thoracic wounds were seen and, consequently, we can have no impression on the percentage of thoracico-abdominal wounds which had late complications. Apart from the group which are discussed herein there have been others who were sent to the center because of a residual hemothorax or a retained foreign body. These have been excluded because their treatment did not vary from the accepted therapy of such lesions. Others were seen because of a residual diaphragmatic hernia; these have been excluded. It is with the group that had combined lesions in the thorax and the subphrenic area that we are particularly concerned for these posed the most complex problems. A summary of the entire group is presented in Table 1. In all of the cases infection existed below the diaphragm and usually was combined with a lesion above the diaphragm.

FACTORS INFLUENCING DEVELOPMENT OF SUPPURATION

Certain factors that may be of importance in explaining the development of these complications have been investigated and are reviewed. Sixty-five per cent of these patients were injured by shell fragments and the remainder by small arms fire. The wounds were penetrating or perforating in equal numbers. Of the twenty-eight patients with penetrating wounds, seventeen retained the missile at the time of arrival at the thoracic center. Of the seventeen, eleven missiles were above the diaphragm and six were below. All of the latter were within the liver. Since thirty-five of the patients in this series had liver abscesses, it may be seen that a retained foreign body was not necessarily of primary importance in the development of a liver abscess.

The time interval between the original injury and the primary treatment was difficult to determine accurately in every case and there was, naturally, a wide variation from case to case. The earliest treatment received was within three hours of injury and the longest elapsed time before treatment was forty-one hours. The

* Aided by a grant from the Foundation for the Study and Treatment of Thoracic and Related Diseases, 1180 Beacon Street, Brookline, Mass.

average elapsed time before primary treatment was begun was sixteen hours which is exactly comparable to a group of patients admitted with infected hemothorax.[4] This is remarkable when one remembers how severely injured these patients are and how much time must be expended in the treatment of shock and the associated cardiorespiratory difficulties.

The type of original treatment is of some interest. Fifteen per cent received either no treatment at all before admission to the center or received only débridement and closure of the wound of entrance; 32.5 per cent had laparotomy alone; 40 per cent had thoracotomy alone and 12.5 per cent had combined thoracotomy and laparotomy.

The onset of symptoms related to the suppurative complication was early and usually within ten days it was apparent that a complication was developing. The majority of the patients were acutely ill and had temperature elevations of the plateau type occasionally associated with chills. Severe jaundice was present in only two of the patients with liver abscess and four others had a mild degree of jaundice. However, a slight elevation of the icteric index without clinical evidence of jaundice was presented in about half of the patients with a liver abscess.

The expectoration of bile was a symptom in nine of the cases. In one there was a direct communication between the liver and lung and the remaining eight patients had intervening empyemas with bronchopleural fistulas. This symptom was especially distressing to the patient and in our opinion was an indication for immediate corrective operative treatment

Important factors in the development of the late complications were the type and duration of drainage afforded the liver or subphrenic lesion at the time of the original treatment. In the group of forty-six right-sided injuries only eighteen patients had any type of postoperative drainage. This was almost always described as a "stab wound drain to the subphrenic space" brought out subcostally to the nearest part of the abdomen or flank. In only eight cases could we determine when the drain had been removed. Usually it was removed between the third and seventh days; in only one case was the drain left for fourteen days. In our opinion stab-wound drainage for such a short time is not adequate for a right-sided thoracico-abdominal wound in which there is liver damage.

The types of infecting organisms usual to war wounds were found in this group of cases. Of the fifty-six patients presented, culture reports for fifty-one are available. In three there was no growth in what was obviously purulent fluid; in one other where the fluid was almost pure bile no growth occurred. The clinical course of these four was that of sepsis. The findings at operation did not differ from the others.

The cultures of the remaining forty-seven are briefly reviewed. In twenty-three a single organism was grown and in twenty-four there were multiple organisms. The

TABLE 1

DISTRIBUTION OF SUPPURATIVE COMPLICATIONS OF THORACICO-ABDOMINAL WOUNDS

Right Side—46		Left Side—10	
Subphrenic infection without pleural involvement	14	Subphrenic infection without pleural involvement	1
Subphrenic abscess	7		
Hepatic abscess	6		
Subphrenic and Hepatic abscess	1		
Subphrenic infection with pleural involvement	32	Subphrenic infection with pleural involvement	9
Infected hemothorax	30	Infected hemothorax	7
with subphrenic abscess	2	with subphrenic abscess	3
with hepatic abscess	28	with herniation of stomach	2
Uninfected hemothorax	2	with gastropleural fistula	2
with subphrenic abscess	1	Uninfected hemothorax	2
with hepatic abscess	1	with subphrenic abscess	2

most common organism was the hemolytic streptococcus which was found in fifteen patients. The Staphylococcus aureus occurred in twelve and the Clostridium welchii in thirteen. The Aerobacter aerogenes and the Friedlander bacillus each appeared ten times. It is probably of greatest interest that the organisms grown from thirty-two of the forty-seven patients were penicillin resistant and in four others the organism was less than 50 per cent as sensitive as the standard strain.

DIAGNOSIS

In the majority of our patients the diagnosis was not difficult. Any patient with persistent fever whose original wound had been thoracico-abdominal was always suspected of having a suppurative subphrenic complication and a diligent search for it was made. Even when there was an obvious reason for the fever within the pleural cavity, a subphrenic component was still sought. The expectoration of bile was an obvious sign. The persistence of a draining sinus from under the diaphragm was always suspected and investigated.

The routine admission roentgenogram often gave a clue to the diagnosis. Elevation of the diaphragm on the affected side was the most common finding in this group. The presence of subphrenic air was uncommon but when present it was considered diagnostic. The roentgenogram was least helpful in those patients who had extensive pleural involvement since the diaphragm was obscured.

Thoracentesis was always performed in patients with pleural fluid and often this single procedure established the diagnosis. The aspiration of bile-stained fluid was convincing evidence of a subphrenic component and diaphragmatic perforation. To enhance the establishment of a correct diagnosis we have always introduced radiopaque oil into the pleural cavity whenever purulent fluid was aspirated. By placing the patient in various positions following the injection we could often demonstrate the diaphragmatic perforation and the extent of the subphrenic component. The information thus obtained was also of value in achieving more direct and adequate drainage of both subphrenic and pleural lesions.

Frequently the aspiration of what was thought to be pleural fluid proved to be from the subphrenic space when the injected oil was visualized by roentgenogram. Whenever the lesion was suspected of being subphrenic, aspiration was performed below the costal margin of the twelfth rib. In a few instances, however, when the diaphragm was elevated and fixed as determined by fluoroscopy, direct transpleural aspiration of a subphrenic lesion was practiced.

TREATMENT

Subphrenic Abscess

The surgical treatment of subphrenic abscess has been discussed by Ochsner,[5] Faxon[6] and others. In the operative treatment of this group of patients we followed the surgical technic described by these authors. Whether the abscess existed alone or in combination with a pleural lesion, the treatment was the same. There were seventeen patients with subphrenic abscesses, eleven right-sided and six left-sided. Of the right-sided lesions, four were anterosuperior, six posterosuperior and one involved both of these spaces. All of the left-sided lesions were posterior in position. Two of the right-sided and one of the left-sided abscesses were approached surgically along a previous sinus which traversed an adherent pleura and diaphragm. Otherwise the drainage was by the anterior or posterior extraperitoneal and extrapleural route.

The results of drainage were satisfactory in every case and progressive healing of the abscesses occurred. There were no deaths. It is to be emphasized that wide open drainage is necessary for in most cases healing of the skin wound will be more rapid than closure of the abscess cavity. The drainage material used was soft latex

FIG. 1. Case 1. Anteroposterior and lateral x-rays on admission demonstrate air beneath the diaphragm and the shell fragment within the liver.
FIG. 2. Case 1. Anteroposterior and lateral x-rays after the injection of radiopaque oil; the posterosuperior subphrenic space is outlined.

tubes which have a definite advantage in holding the wound edges apart.

Postoperatively the patients were allowed out of bed the day following operation. They were immediately instructed in the use of specific remedial breathing exercises which were continued until healing was complete.[7]

CASE 1. E. F., a twenty-five year old infantry captain, was struck in the right axilla by a shell fragment. No wound of exit was found. Twelve hours later operation was performed at an evacuation hospital. The wound of entrance was débrided and shattered rib fragments were removed from the chest wall. The pleura was opened and a laceration of the lung repaired. A wound of the diaphragm was opened and a shell fragment removed from the liver. The diaphragm was repaired after a Penrose tube drain had been brought out subcostally to the flank. The chest was closed and an intercostal tube inserted. The lung remained well expanded and on the third day the intercostal tube was

removed. The subcostal drain was left in place until the thirteenth day when it was removed. The patient was then evacuated to the rear. Purulent material drained intermittently from the subcostal drainage wound thereafter.

On admission to the thoracic center the patient's condition was excellent. There was a small subcostal sinus which drained a small amount of purulent material. Roentgen examination (Fig. 1) demonstrated a foreign body within a cavity in the right subphrenic space. Oil injection through the sinus demonstrated the location and size of the cavity. (Fig. 2.) Approximately two months after the original injury operation was performed at the thoracic center. After resection of a 4 inch segment of the tenth rib a large subphrenic abscess cavity was entered. The foreign body was easily found and removed from a superficial cavity within the dome of the liver. Open drainage was maintained by means of latex tubes. The patient's course was satisfactory (Fig. 3) and the wound was well healed seven weeks later.

FIG. 3. Case 1. Anteroposterior x-ray after drainage of the abscess; a small amount of oil is still present in the subphrenic space.

Hepatic Abscess

Thirty-six patients were treated for liver abscesses. In nine cases the abscess did not communicate with the pleural cavity; in the remainder of cases it did. In one patient the abscess had ruptured directly into the lung and drained through a bronchus without establishing a pleural abscess.

The nature of the traumatic liver abscess differs considerably from the pyogenic abscess usually seen. On opening into such an abscess the contents usually consist of large masses of necrotic liver substance with small pockets of purulent material. In many of the patients this necrotic material had not completely separated from the surrounding normal liver tissue. As a result removal of the slough was often accompanied by severe bleeding from the liver and it soon became apparent that forceful separation was not wise. Because of this incomplete separation of necrotic liver wide open drainage was necessary; usually the amount of drainage was great during the first ten to fourteen days. A further result of the incomplete separation was the large amount of bile drainage that occurred after evacuation of such an abscess. This usually continued until a granulating wall lined the entire cavity.

Drainage of these abscesses was usually accomplished through the nearest point on the chest wall since there usually were pleural adhesions which safely permitted direct approach. If pleural adhesions were not apparent, a subcostal route as for a subphrenic abscess was employed. At operation the cavity was evacuated as completely as possible and the wound packed widely open with activated zinc peroxide impregnated gauze. In our experience the use of activated zinc peroxide was of definite benefit in hastening the evacuation of necrotic liver tissue and in diminishing the amount of bile drainage. The pack was changed every second day until bile drainage ceased when latex-tube drains were used until healing was complete. Again we emphasize the use of wide open drainage which permits the easy removal of slough and foreign bodies when present. It also facilitates adequate packing of the cavity when severe bleeding occurs.

In all patients who had uncomplicated liver abscesses the result was excellent although healing was slow. There were no deaths.

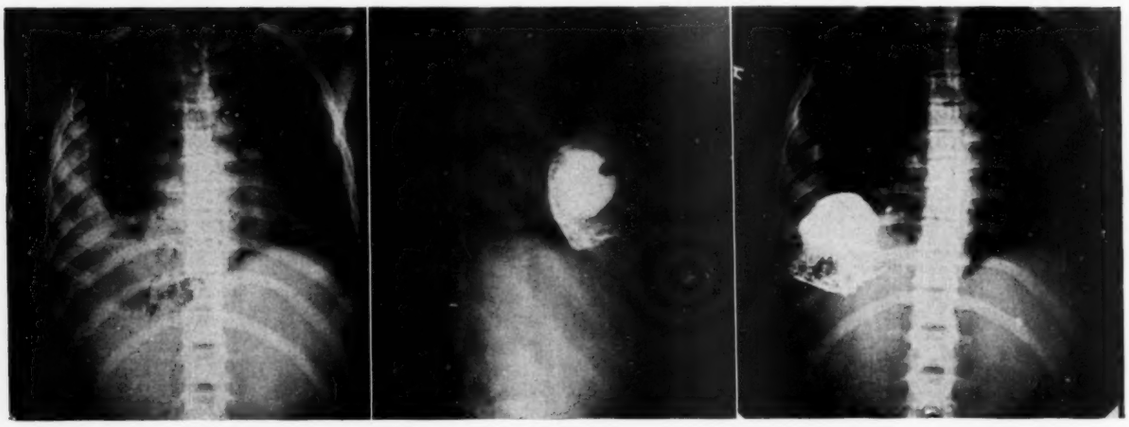

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FIG. 4. Case II. Anteroposterior x-ray on admission; overexposed technic. This demonstrates the pleural fluid and a large air bubble within the liver areas.

FIG. 5. Case II. Anteroposterior and lateral x-rays after the injection of iodized oil; these outline the extent and exact location of the liver abscess.

CASE II. V. N., a twenty-two year old infantry private wounded by a shell fragment in the right mid-axillary line, was admitted to an evacuation hospital ten hours later in good condition. A thoracotomy was performed and a large shell fragment removed from the liver. The liver was repaired and a subcostal drain was brought out to the flank. The diaphragm was repaired and the chest closed without drainage. Two days later the roentgenogram showed that the right lung had collapsed and air and fluid were present in the pleural cavity. Drainage from the subcostal wound was slight.

The patient arrived at the thoracic center ten days after injury. His general condition was poor. The subcostal drain had been removed and the wound was healed. Roentgen examination showed elevation of the right diaphragm with an air bubble beneath it. There was a right pleural effusion compressing the lung. (Fig. 4.)

Thoracentesis high posteriorly was productive of thin, serous fluid which was sterile on culture. Aspiration low in the right axilla produced thick, yellow, purulent material from which hemolytic streptococci grew on culture. Oil replacement was performed. (Fig. 5.)

Operation was performed through the old thoracotomy incision for in this area the diaphragm appeared to be adherent. A large hepatic abscess was entered and evacuated. The liver was adherent to the diaphragm obliterating the subphrenic space. The pleural effusion was treated adequately by repeated thoracentesis. The patient's course was satisfactory although complete healing was protracted.

Combined Lesions without Diaphragmatic Communication

Patients who had both a pleural and a subphrenic lesion without a demonstrable communication at the time of our examination will be discussed in this group in which there were seven patients. In four the pleural component was not infected as demonstrated by the different character of the fluids aspirated from the pleural cavity and from the subphrenic space. In those cases in which the fluid was similar neither lipiodol injection nor operation revealed a perforation.

The lesions in this group were considered and treated as though they existed independently. When operation was necessary for both lesions, the combined procedure was performed at the same sitting. In all the subphrenic lesions were treated as already described. If there was no infection within the pleural cavity, aspiration or decortication if necessary was performed.

CASE III. M. V., a twenty-five year old infantry lieutenant, was wounded by a rifle bullet which entered the left upper quadrant of the abdomen, penetrated the left upper abdomen and made its exit through the left axilla. Twelve hours after wounding an operation was performed at a field hospital. The wounds of entrance and exit were débrided. Abdominal exploration was performed and a

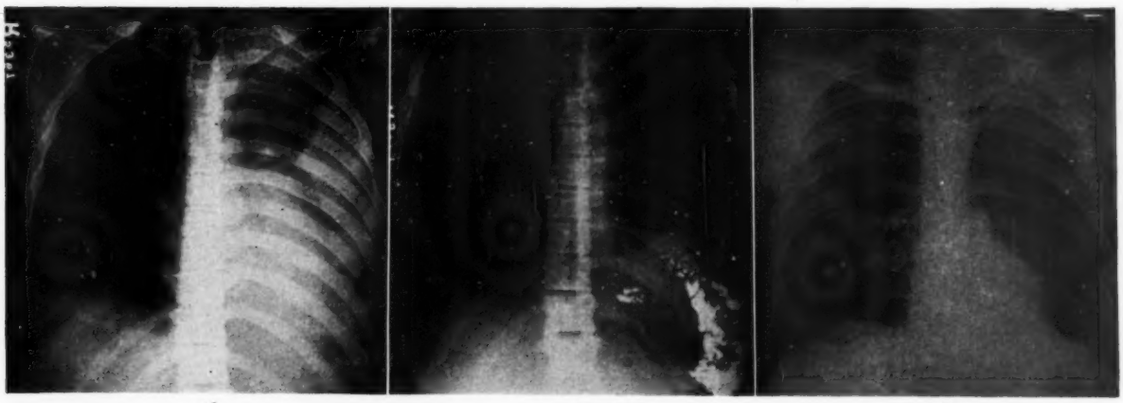

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FIG. 6. Case III. Anteroposterior x-ray on admission; this demonstrates an extensive left pleural effusion.
FIG. 7. Case III. Anteroposterior x-ray after the removal of 2,000 cc. of blood from the pleural cavity and the injection of radiopaque oil into the subphrenic space posteriorly; the marked elevation of the diaphragm after removal of the pleural fluid was one indication of the subphrenic lesion.
FIG. 8. Case III. Anteroposterior x-ray after drainage of subphrenic abscess.

resection with anastomosis was performed because of a perforation of the jejunum.

The patient was admitted to the thoracic center eight days after wounding and his general condition was excellent. There was moderate dyspnea and persistent fever. There was some localized tenderness in the left flank and lower chest posteriorly. All wounds were well healed. Roentgen examination (Fig. 6) demonstrated a left pleural effusion of marked degree. Thoracentesis was performed high on the left side and serosanguineous fluid was obtained. Aspiration in the eleventh interspace was attempted and creamy, yellow, purulent material was obtained. Lipiodol was injected after aspiration. (Fig. 7.) Culture of the fluid produced a Cl. welchii and a hemolytic streptococcus.

Three weeks after the original injury a posterior approach was made into the left subphrenic space by resection of the twelfth rib. A large cavity was entered and completely drained. The wound was held open by multiple latex tubes. Repeated thoracenteses were necessary for the removal of all pleural fluid and the patient made an uneventful recovery. The subphrenic wound was healed five weeks after operation. (Fig. 8.)

If the pleural component proved to be infected, more radical treatment was needed for the pleural disease. Either open drainage or decortication was performed according to indications. Briefly, it was our custom to reserve decortication for those patients whose infected hemothorax was greater than 500 cc. in size. If it appeared smaller than this, open drainage was considered the operation of choice. The technic of decortication is illustrated in Figure 13.

CASE IV. D. R. P., a twenty-one year old infantry private, was wounded in Germany by a machine gun bullet. The bullet entered the right posterior axillary line and, after penetrating the chest and upper abdomen, made its exit in the right upper abdomen. Twelve hours after injury operation was performed. Through an abdominal incision the laceration in the diaphragm was located and repaired. A Penrose cigarette drain was brought out from the subphrenic space onto the right flank. There was no other abdominal injury. Penicillin was given in large amounts and after three days the flank drain was removed. The patient was then evacuated to the United Kingdom base. At a general hospital repeated aspirations of the chest were performed, removing large amounts of purulent material. Penicillin replacement was performed at each aspiration but there was no improvement in the general condition of the patient nor in the size of the empyema cavity.

The patient was then referred to the thoracic center. His general condition on admission was fair and all wounds were well healed. The chest signs were those of total effusion and the abdominal examination was negative. Roentgen examination (Fig. 9) demonstrated a massive pleural effusion on the right. Thoracentesis was

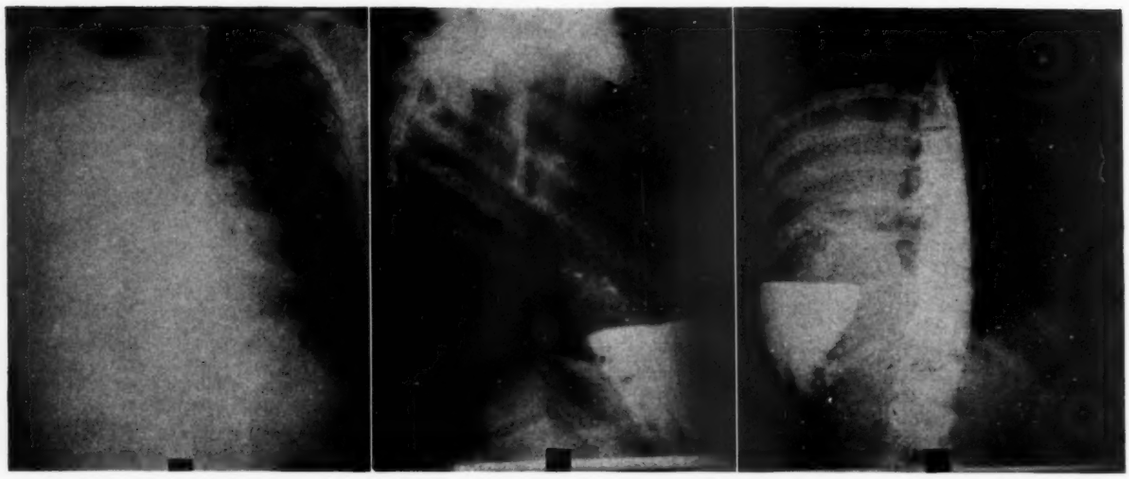

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FIG. 9. Case IV. Anteroposterior x-ray on admission demonstrating a total hemopneumothorax.
FIG. 10. Case IV. Anteroposterior and lateral x-rays after the injection of radiopaque oil; the oil outlines the anterosuperior subphrenic space and there is no communication with the pleural cavity.

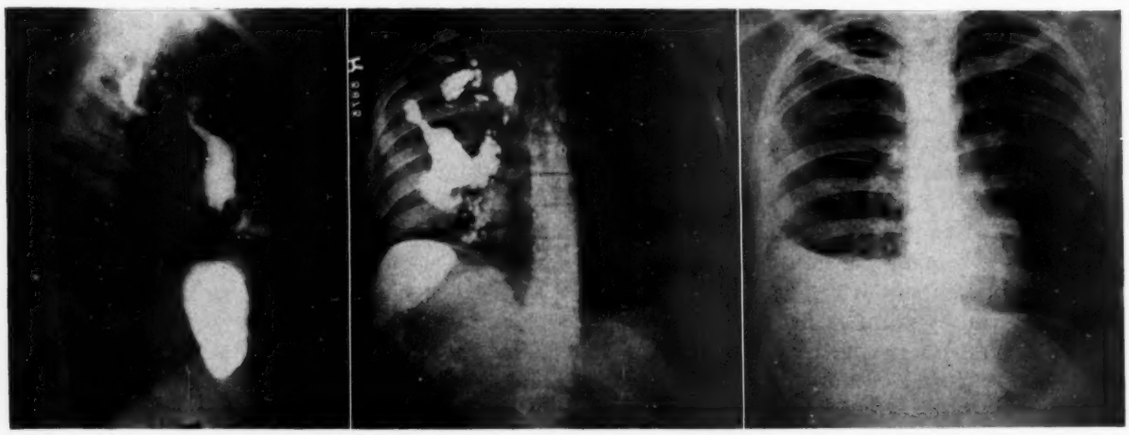

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FIG. 11. Case IV. Anteroposterior and lateral x-rays following the injection of iodized oil into the pleural cavity; these plates are taken with the head of the table lowered. The extent of the anterosuperior subphrenic space is well outlined by the combination of these plates with those in Figure 10.
FIG. 12. Case IV. Anteroposterior x-ray after decortication and anterior drainage of the subphrenic space.

performed low in the mid-axilla and, after removing thick, creamy, yellow, purulent fluid, lipiodol was introduced. The roentgenogram after this demonstrated (Fig. 10) filling of the anterosuperior subphrenic space. There was no oil within the pleural cavity. A second aspiration was then performed in the second interspace anteriorly and the same type of fluid removed. Another 20 cc. of oil were injected. This clearly demonstrated the pleural component without communication with the subphrenic space. (Fig. 11.)

Six weeks after the original injury operation was performed at the thoracic center. A sixth rib resection approach was made to the pleural cavity and a total empyema cavity found. Decortication was accomplished. (Fig. 13.) No perforation in the diaphragm could be found. The chest was then closed after an intercostal tube was brought through the ninth interspace. The patient was then placed on his back and through a 3-inch anterior subcostal incision the anterosuperior subphrenic space was entered extraperitoneally. A large abscess was found and evacuated. It was held open by latex-tube drains.

The postoperative course was uneventful. The patient was up and about from the second postoperative day. The lung was completely expanded from the time of operation (Fig. 12)

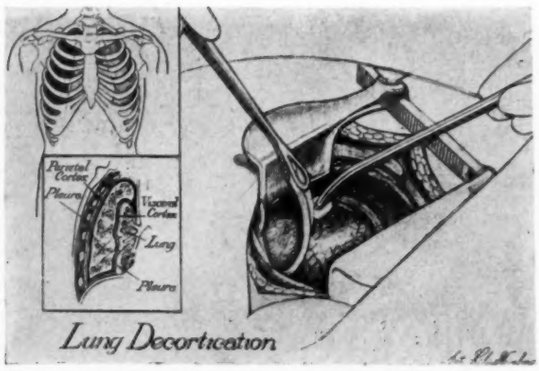

FIG. 13. A clotted hemothorax and technic of decortication; inset illustrates the extent of the cortex and its contents. A sagittal section thereof outlines the relation of the cortex to the lung, parietal pleura and the visceral pleura. Loose debris of broken-down blood elements are shown between the cortical walls. The technic of decortication is illustrated in the large diagram. The visceral pleura is being peeled off the normal underlying lung. (Reprinted with permission of the C. V. Mosby Company. *J. Thoracic Surg.*, vol. 15, 1946.)

and the subphrenic space was obliterated four weeks after drainage.

Combined Lesions with a Diaphragmatic Communication

The largest number of the patients in this series was in this group. Twenty-seven patients had right-sided combined lesions with a liver abscess draining into the pleural cavity through a perforation in the diaphragm. These patients had essentially the same type of liver abscess described in a previous section and the infected hemothorax had all the elements usually seen in thoracic empyema. The treatment used for this combination depended upon the size of the empyema.

If the pleurogram demonstrated an empyema of 500 cc. in size or less with a communication through the diaphragm, open drainage was thought to be the procedure of choice. A wide open rib resection thoracotomy was performed dependently as determined by the pleurogram and all clot and fibrin were evacuated from the empyema. The perforation in the diaphragm was then found and enlarged so that the liver abscess was completely deroofed and adequately drained into the empyema cavity. (Fig. 14.) This allowed

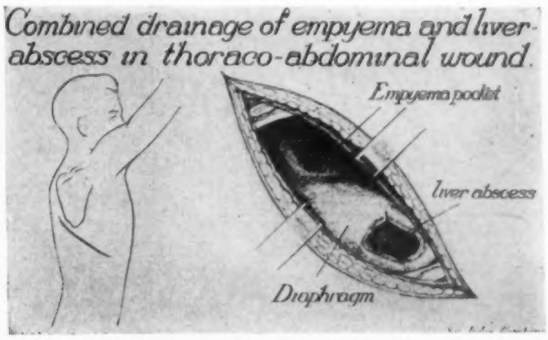

FIG. 14. Thoracotomy by rib resection for drainage of empyema and the transpleural deroofing of subjacent suppurative process. (Reprinted with permission of C. V. Mosby Company. *J. Thoracic Surg.*, vol. 15, 1946.)

complete exposure of the liver abscess so that removal of slough and foreign material was possible. This technic was also life-saving in those patients who had severe bleeding as a complication, for with such drainage adequate packing of the abscess cavity was possible and bleeding could be controlled.

CASE V. S. N., a twenty-three year old infantry private, was struck in the right axilla by a rifle bullet. The missile came to rest within the liver. Fifteen hours after he received the wound a thoracotomy was performed at an evacuation hospital. The diaphragm was opened and the bullet removed from the liver. An omental graft was sutured into the liver laceration. The diaphragm was repaired and the wound closed after re-expanding the lung. A stab-wound Penrose drain was brought from the liver wound to the flank. The postoperative course was uneventful and the drain was removed on the eighth day. The patient was then evacuated and arrived at the thoracic center four weeks after injury.

The patient's condition on admission was good and he complained only of slight pain in the chest. Roentgen examination showed a pleural effusion on the right. (Fig. 15.) Thoracentesis was performed and was productive of thick, yellow, bile-stained, purulent material. Culture of this material yielded a streptococcus hemolyticus and the A. aerogenes. Iodochloral was injected into the pleural cavity. (Fig. 16.) This demonstrated both the empyema cavity and the liver abscess with the perforation of the diaphragm.

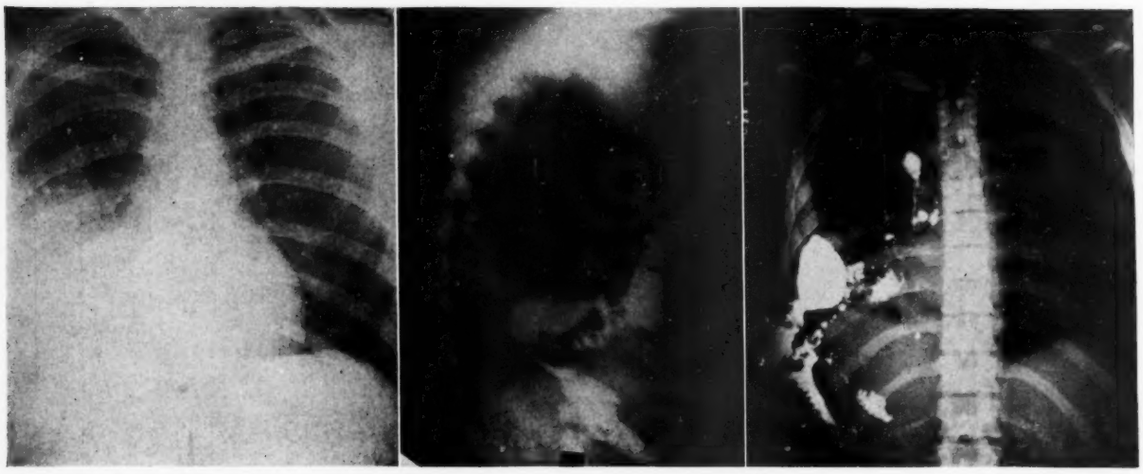

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FIG. 15. Case v. Anteroposterior view of the chest on admission; the pleural fluid involves one-third of the cavity.
FIG. 16. Case v. Anteroposterior and lateral x-rays after the aspiration of bile-stained fluid from the pleural cavity and the injection of radiopaque oil; the extent of the empyema cavity is outlined and the liver abscess is also filled by the infiltration of oil through the perforation in the diaphragm. The point of perforation can also be made out.

Four and a half weeks after the original injury operation was performed and the aforementioned procedure carried out. The opening in the diaphragm proved to be a 1 inch slit which was excised. The liver abscess cavity contained a suppurating omental graft and there were three extensions from the main cavity as can be seen on the roentgenograms. The abscess was opened widely and packed with activated zinc peroxide impregnated gauze. The empyema wound was held open by three tubes. Healing was slow but the cavity had almost completely closed within six weeks.

Twenty-one patients were so treated and the results were satisfactory. The use of the activated zinc peroxide seemed to have some beneficial effect in removing the slough and diminishing the amount of bile drainage. Among the first admissions to the thoracic center the incidence of hemorrhage from the liver abscess was high; this method was considered preferable because of the ease with which the liver abscess could be packed to control bleeding.

There were two deaths in patients so treated. One patient suffered recurrent severe hemorrhages from the liver and after six weeks expired following an exsanguinating hemorrhage. Post-mortem examination showed a large liver abscess which had apparently been extending despite drainage. The second fatality occurred in a patient who had a sudden severe hemorrhage two weeks following operation. The bleeding was controlled and the patient received a transfusion. Following this he developed a fatal hemolytic reaction and expired twenty-four hours later. The cause of the reaction could not be determined.

Although the aforementioned method of treatment was considered satisfactory, it soon became evident that a patient with total empyema had an unduly prolonged course; and the lung remained collapsed for too long a period. It was, therefore, determined to combine decortication with classical subphrenic drainage of the liver abscess in certain of the patients. The indication for the procedure was the existence of an empyema of over 500 cc. size in a patient whose general condition permitted such a radical procedure.

The operation was performed through a conventional posterolateral approach to the pleural cavity, usually removing the sixth or the seventh rib. Decortication of the lung was then accomplished. (Fig. 13.) Once this was completed the perforation in the diaphragm was found and the liver abscess explored and evacuated. The near-

est point on the chest wall was then determined and a subphrenic opening from the abscess to this point was performed. This was made in as wide open a fashion as possible and in such a way that easy access to the liver abscess was obtained. The diaphragm was then repaired. The parietal cortex was removed if the patient's condition permitted. If his condition did not permit, this step was omitted. Intercostal tube drainage of the pleural cavity was obtained through a low interspace and the chest wall was closed in layers after expansion of the lung. The liver abscess was packed with activated zinc peroxide impregnated gauze. This pack was changed every third day. The intercostal tube was removed when the lung was fully expanded, usually from the third to the fifth day.

CASE VI. S. R., a twenty-seven year old infantry corporal, was struck by an enemy rifle bullet in the right anterior chest at the fifth interspace. The bullet made its exit posteriorly at the eleventh rib. At an evacuation hospital the patient's condition was satisfactory and no surgery was performed. A thoracentesis was performed, removing 2 L. of old blood. He was evacuated to the rear and one week later a second thoracentesis was performed which yielded 500 cc. of serosanguineous fluid. He was admitted to the thoracic center fifteen days after being wounded.

The condition of the patient on admission was fair. There was marked dyspnea and moderate chest pain. The patient appeared slightly icteric and the icteric index was 9. He had repeated daily chills with a temperature rise to 103°F. Roentgenograms demonstrated total effusion on the right. (Fig. 17.) Thoracentesis revealed that the fluid was thin, purulent and grossly bile stained. Lipiodol was injected which demonstrated both the pleural component and a liver abscess. (Fig. 18.)

Three weeks after injury operation was performed. The seventh rib was removed and decortication of the collapsed lung accomplished. A 1 inch circular opening in the posterior part of the diaphragm was found and the abscess in the liver was explored and evacuated. It was drained externally to the posterior chest wall by the resection of a 2 inch segment of the eleventh rib. The diaphragm was then repaired and the parietal cortex removed. The thoracotomy incision was closed in layers.

FIG. 17. Case VI. Anteroposterior x-ray on admission; there is a massive pyohemothorax.

The patient's postoperative course was satisfactory. The intercostal tube was removed on the third day. The liver abscess pack was changed every third day. The patient was up and about from the second postoperative day. (Fig. 19.) There was a febrile episode two weeks after operation and the liver abscess was re-explored under anesthesia at which time a small pocket was found. Following this the patient made a satisfactory recovery and the abscess was healed five weeks after operation.

This procedure was performed eight times and was completely successful in seven. In one patient a small empyema developed postoperatively which required open drainage. However, the pocket was small and readily responded to this treatment. Certainly the time required for complete healing was greatly reduced even in this patient whose result was not perfect because a total empyema had been converted into one of about 200 cc. in size by decortication and re-expansion of the lung.

In the case of two patients the procedure was staged because of their poor condition at the time of admission. The empyema was drained openly and the liver abscess evacuated into the empyema in the

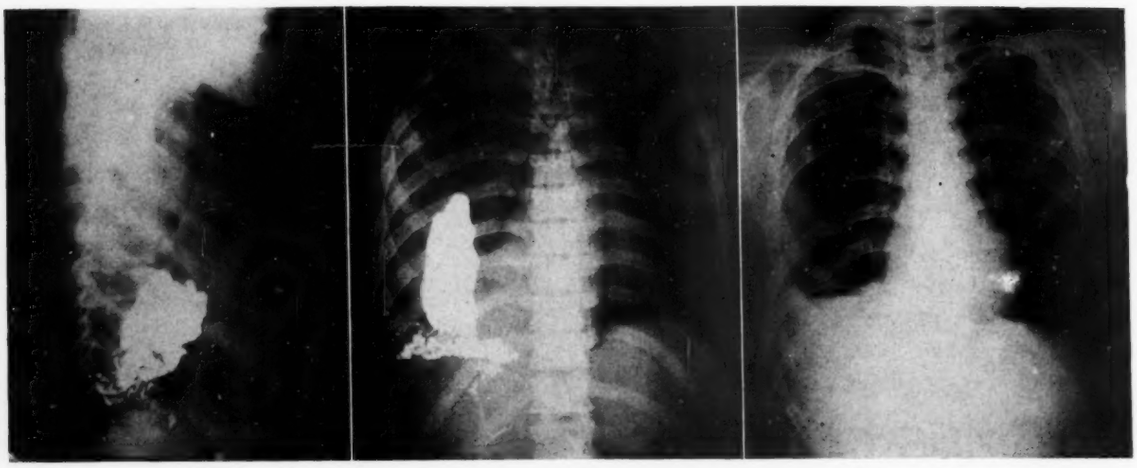

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FIG. 18. Case VI. Anteroposterior and lateral x-rays after the removal of bile-stained purulent fluid and the injection of radiopaque oil; the perforation leading to a small liver abscess can be seen.
FIG. 19. Case VI. Anteroposterior view after decortication and posterior drainage of the liver abscess.

first stage. When the patient's condition permitted, decortication with subphrenic drainage of the liver abscess was performed. At this stage the diaphragm was closed and the open rib resection wound was débrided and closed. This technic was successful in both patients and served to shorten the period of illness by many weeks.

Those patients with left-sided, combined lesions whose perforation persisted presented a more complicated problem and one which demanded individual treatment for the specific problem presented. Four of our patients had a herniation of the stomach into the infected pleural cavity. In two the stomach was open into the pleural cavity and a gastropleural fistula was present which evacuated all the gastric contents into the chest. Both of these patients had had rib resection and drainage of the empyema before admission to the thoracic center. The other two patients had large, incarcerated, diaphragmatic herniations of the stomach into the infected hemothorax. At operation both of these proved to have a laceration of the stomach which had become sealed off against the posterior chest wall.

All of these were treated in much the same fashion by radical surgery which aimed at the repair of the stomach and its return to its normal position, repair of the diaphragm and re-expansion of the lung by decortication.

CASE VII. L. G. C., a twenty-eight year old infantry private was struck by an enemy rifle bullet in the right lumbar region just above the iliac crest. The bullet traversed the spinal canal, the left upper abdomen and came to rest in the left pleural cavity. The patient was evacuated immediately to a neurosurgical center because of a total cord lesion below the first lumbar level. At that hospital examination of the chest demonstrated absent breath sounds over the entire left side and roentgenogram was said to show an elevated diaphragm. The bullet was made out in relation to the diaphragm. (Fig. 20.)

Four days after injury vomiting occurred and the patient was unable to retain fluids. Wangensteen suction was instituted which controlled this symptom.

The patient progressed satisfactorily after the gastric suction was removed. On the twelfth day after injury a suprapubic cystostomy was performed. Twelve days later the symptoms of gastric obstruction recurred and the patient was sent to the thoracic surgery center.

The condition of the patient on admission was fair. He was placed on a liquid diet and given transfusions of blood and plasma. His temperature rose to 102°F. each day. A barium meal demonstrated that the greater part of the stomach was within the chest

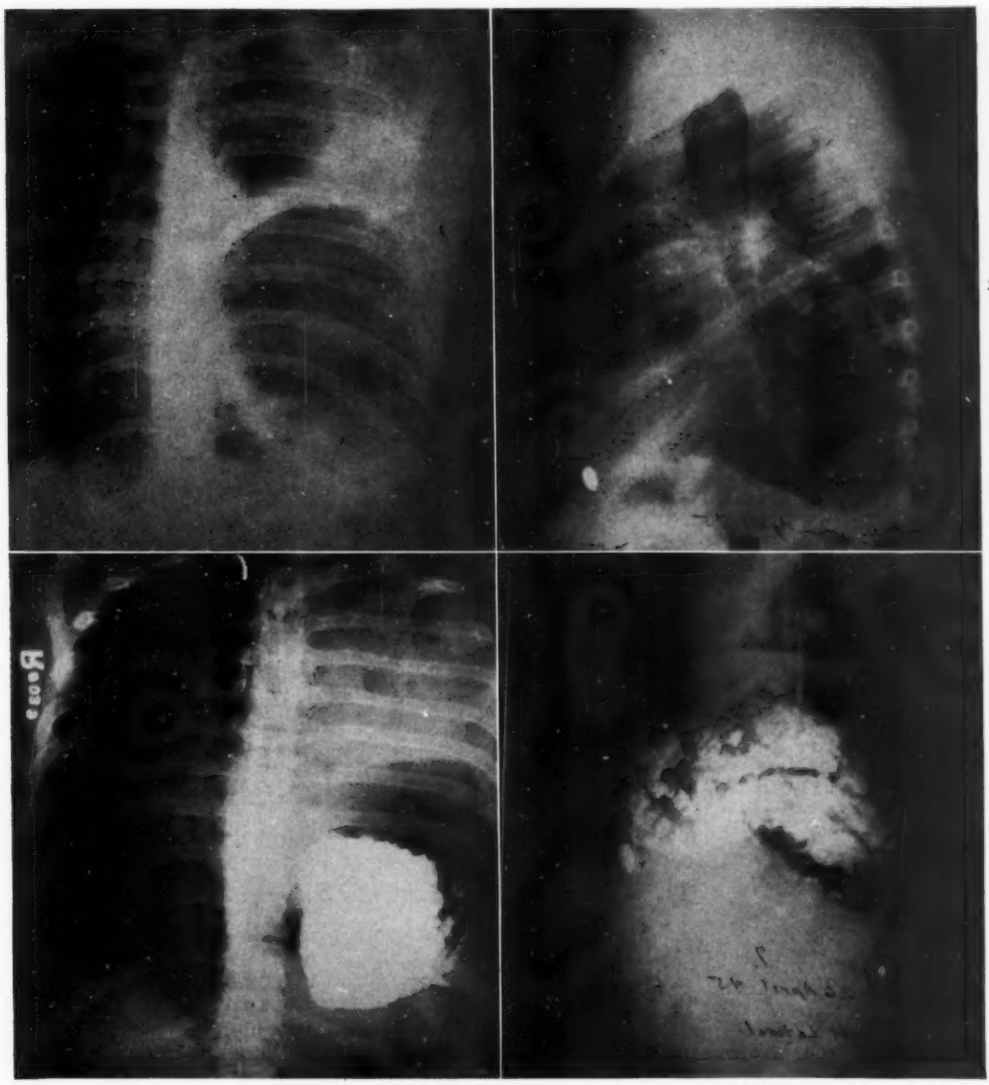

FIG. 20. Case VII. Anteroposterior and lateral x-rays on admission; the bullet can be made out anteriorly in the pleural cavity.
FIG. 21. Case VII. Anteroposterior and lateral x-rays after a barium swallow; the entire stomach is within the pleural cavity.

and that there was a massive effusion above this. No attempt at aspiration was made. (Fig. 21.)

Approximately one month after the injury operation was performed for the incarcerated diaphragmatic hernia. A posterolateral incision was made; and after an 8 inch segment of the ninth rib was removed, the pleura was opened. The stomach was almost totally within the chest and was adherent to the diaphragm, pericardium, pleura and the collapsed lung. The lung was totally collapsed and bound down by a thick, fibrous cortex. The pleural cavity contained clotted infected blood. The stomach was dissected free; on its posterior wall was a 3 cm. defect which had been adherent to the chest wall. This was opened during the dissection. The stomach was repaired with silk and restored to the abdomen. The diaphragm was closed with a double row of interrupted fine silk sutures. Decortication was then performed and the lung completely ex-

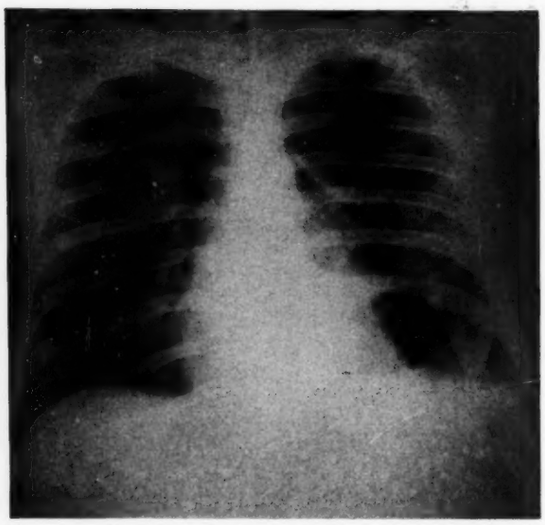

FIG. 22. Case VII. Anteroposterior x-ray after repair of the diaphragmatic hernia and decortication of the infected clotted hemothorax.

panded. The bullet which had been free within the pleural cavity was removed. Intercostal drainage was provided by a tube through the tenth interspace.

The postoperative course was uneventful. The lung remained expanded and the tube was removed on the third day. (Fig. 22.) Gastric drainage was stopped on the third day and fluids were started by mouth. The patient then went on to a full diet without incident. A small empyema pocket became apparent about the tenth day and was opened; this pocket was 100 cc. in size.

Such patients present complex problems and require individual evaluation and treatment. In this patient the combination of an infected hemothorax, a pleural foreign body and incarcerated diaphragmatic hernia with perforation of the stomach were present. This was further complicated by the cord lesion with paralysis of the lower extremities, bladder and rectum. It is admitted that such surgery in these patients is serious but the restoration of the stomach to its normal position and the return of function to the lung are of such great benefit to the patient that his general condition is restored to normal within a week after operation. On the other hand, delay will definitely increase the debilitation which will militate against successful surgery at a later date.

SUMMARY

A review of fifty-six patients with suppurative complications of thoracico-abdominal wounds has been presented.

The technic of radiopaque oil injections into the pleural cavity has been discussed. This procedure is most valuable as a diagnostic measure and as an aid in attaining the proper surgical approach.

The combination of the operation of decortication of an infected hemothorax with subphrenic drainage of a liver abscess is described. This was developed as the most satisfactory means of restoring pulmonary function and at the same time achieving drainage of an abscess in a difficult location.

Emphasis is placed on the value of specific remedial breathing exercises in restoring to normal the function of the injured chest.

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ARTERIAL BLOODLETTING DURING OPERATION AS AID IN HEMOSTASIS*

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CONTROLLED arterial hypotension for the reduction of blood loss during operation is established by removal of blood from the patient's radial artery during operation. This blood is then reinfused in a retrograde (cardiad) fashion into the same vessel as it is needed toward the end of the operation. Obviously this procedure is indicated only in cases in which the surgeon encounters bleeding which would endanger life or function.

This procedure is based on the work of Kohlstaedt and Page[1] who proved that intra-arterial transfusion is more effective than intravenous transfusion in the treatment of terminal hemorrhagic hypotension. In their experimental study they placed a cannula in the femoral artery of an anesthetized dog directing it toward the heart and the animal was allowed to bleed rapidly into a closed reservoir until it was in hemorrhagic shock. By this method they rapidly reduced the blood pressure to 50 mm. Hg at which it was held for ninety minutes and then still further reduced it to 30 mm. Hg for an additional forty-five minutes. They found that they could hold the blood pressure at any desired level by maintaining that level of pressure in the blood reservoir and allowing the pressure in the arterial tree to come into equilibrium with it. Clotting of the removed blood was prevented by the addition of heparin.

At the end of the procedure, with the animal at the borderline of irreversible shock, the blood was reinfused by raising the pressure in the blood reservoir. This forced the blood back up the femoral artery into the aorta. By this method the reinfusion of 50 per cent of the removed blood resulted in the recovery of 75 per cent of the animals. Intravenous reinfusion of the same amount of blood into animals in the same degree of hemorrhagic shock resulted in recovery of only 30 per cent. The feasibility of intra-arterial transfusion in man was demonstrated in a number of patients suffering from shock or severe hypotension.

At first glance this method of infusion by forcing blood in a retrograde fashion into an artery appears unphysiologic. Actually, however, a little reflection will show that it is the most physiologic method of combating hemorrhagic shock. The primary function of the heart is to maintain a normal head of pressure in the elastic aorta. In hemorrhagic shock the heart is no longer able to perform that function. In this state, failure of cardiac output is a reflection not only of the reduction of blood volume but also of an actual loss of myocardial efficiency. The loss of efficiency is the result of myocardial ischemia due to decreased aortic pressure.[2–4] Therefore, the cardinal requirement in combating hemorrhagic shock is restoration of the pressure in the aorta. There can be no more physiologic method of accomplishing this than the injection of the animal's own arterial blood into the arterial tree. When this is done, the coronary and cerebral blood flow are rapidly restored before the burden of an increase in venous pressure and blood volume are thrown on the weakened heart. In its performance, therefore, the closed reservoir which returns the arterial blood to the arterial tree may be likened to an accessory heart.

The absolute control of arterial pressure afforded the investigator[5] by this procedure suggested to us that it could be used to

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advantage as a safety measure during operations in which the surgeon anticipates serious or inaccessible bleeding. In the removal of certain types of intracranial tumor,[6] for instance, the neurologic surgeon can anticipate loss of blood requiring several transfusions. The patient may go into shock during the operation and recover after an intravenous transfusion is given; but occasionally, as every surgeon knows, this method of resuscitation may fail. The reason is that when a patient in severe shock is given a transfusion by the usual intravenous method, an additional load is thrown upon the flabby, ischemic heart muscle which must pump the injected blood through the pulmonary circulation and then out into the aorta before the heart itself can benefit. This transient overloading of the weakened heart is avoided if the patient receives the blood by retrograde arterial injection.

In adapting this procedure of arterial bloodletting and reinfusion to the human subject certain changes in apparatus and technic were made. The apparatus which is illustrated in Figure 1 consists of a glass Y cannula from which lead two rubber tubes. The rubber tubing used in this apparatus is 6.5 mm. in diameter and the lumen is 3 mm. in diameter. One of these tubes, the bleeding tube, leads directly to a flask containing 50 cc. of 4 per cent sodium citrate solution or one of the A.C.D. solutions in sufficient quantity to prevent clotting in 500 cc. of blood. The other tube, which is the supply tube, has three connections, one to an aneroid manometer, another to a Kelly flask and a third to a reservoir of heparin. The manometer tube

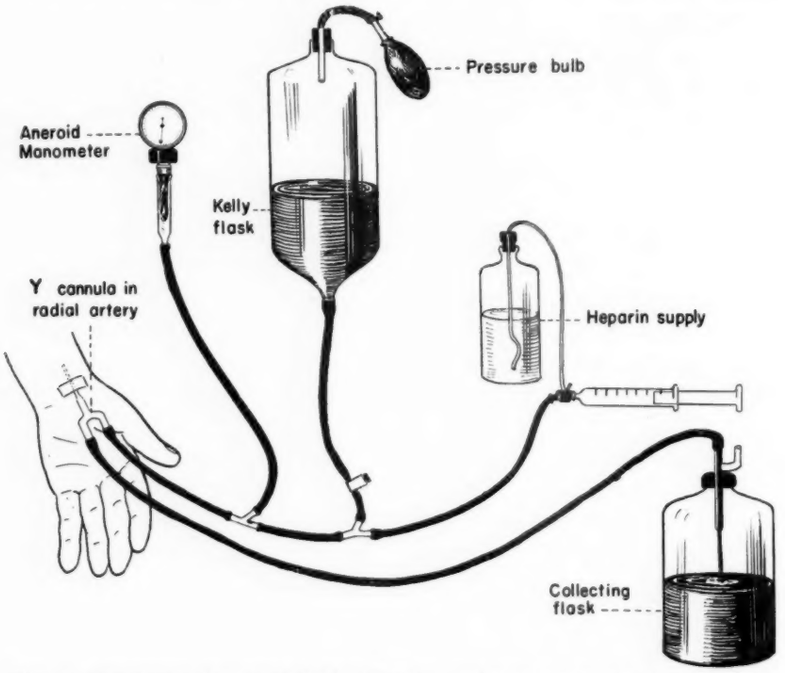

FIG. 1. Apparatus for arterial bloodletting and reinfusion; the lower tubing leads from the glass Y cannula in the artery to the blood-collecting flask which contains 50 cc. of 4.0 per cent sodium citrate solution. The upper tubing provides for injection of heparin solution (0.01 per cent), dial for registering intra-arterial pressure, and vessel for returning blood through cannula under measured pressure. The rubber tubing, of course, is clamped except during the actual removal or reinfusion of the blood. Previous reports[8,10,11] described a Murphy drip inserted in the rubber tubing leading from the supply vessel. This has been replaced by the float-containing visible drip device in order to prevent the possibility of the entrance of air into the artery.

leads to a glass tube about 8 cm. in length and 2 cm. in diameter which is tapered so as to fit inside the rubber tubing. Into the large end of this tube is fitted a single hole rubber stopper. In setting up this piece of apparatus a finger cot or the ring finger from a No. 7 surgical glove is fitted over the rubber stopper which is then securely seated in the open end of the glass tube. The manometer is then fitted into the hole in the rubber stopper. In use the finger cot or glove finger contains air and the remainder of the tube is filled with the solution which is continuous with the blood in the radial artery. Thus pressures in the radial artery are communicated through the finger cot to the air inside it and thus are registered on the manometer. The Kelly flask is connected directly through a Macintosh* drip to the supply tube and is fitted with a rubber stopper through which pressure may be applied using a hand bulb. The supply tube should be fitted with the drip in which a glass float sinks with the last of the fluid and acts as a stopper, preventing air embolism. The heparin reservoir consists of a 400 cc. bottle, syringe and three-way stopcock by means of which the heparin solution can be injected into the whole system of tubing at will. The heparin solution is prepared by adding 4 cc. of 1 per cent heparin to 396 cc. of physiologic saline solution. The apparatus is assembled as indicated in Figure 1 and all the tubings are filled with 0.01 per cent heparin solution. Care is taken to see that the glass tube to which the manometer is attached is filled with fluid which contains no air bubbles and to see that the finger cot is filled with air under atmospheric tension only. If the finger cot is overdistended at the time that the manometer is affixed to the rubber stopper, there will be a false positive reading owing to this pressure. The Kelly flask is attached to the set after a small amount of saline has been used to fill its tubing. All air must be removed from this tubing in order to avoid infusing bubbles with the blood.

*A. Charles King, Ltd., London.

The upper extremity is fixed to the arm board, the wrist being held in slight hyperextension in order to expose the area for the incision. The radial artery is identified by palpation and a 2 cm. longitudinal incision is made immediately over it opposite the styloid process of the radius. The deep fascia is separated by passing a hemostat into it and then separating its blades. Fibers which do not separate readily are incised with a scalpel or scissors. The artery then is freed from the veins and adjacent tissues and is exposed by slipping a hemostat beneath it. (Fig. 2.) The artery is occluded proximally and distally by passing a silk suture about it and then clamping this suture but not the artery. (Fig. 3.) A triangular opening is made in the artery by using a sharply pointed scalpel. The artery is transfixed by this instrument which is then drawn distally and anteriorly making the incision. (Fig. 4.) The tip of the cannula is passed into this incision and as it comes in contact with the occluded portion of the artery the hemostat is loosened and the cannula is advanced until it fits snugly by reason of its taper. The ligature is now used to tie the cannula in the artery whereupon one end of this suture is carried around the Y of the glass catheter and is tied to the other to secure it safely in position. (Fig. 5.)

As long as this cannula is in the artery it is important to inject through it at intervals of five minutes 3 cc. quantities of the heparin solution. This solution is injected into the artery while the bleeding tube is obstructed so that the anticoagulant actually comes in contact with the tip of the cannula and the adjacent intima of the artery.

The bleeding is begun when the cannula has been secured in place. During the bleeding the rubber tubing between the glass cannula and the manometer is clamped with a suitable forceps. Rubber-shod Allis forceps are satisfactory for this purpose. The blood is allowed to flow as rapidly as possible until 500 cc. have been withdrawn. A flask is then substituted for

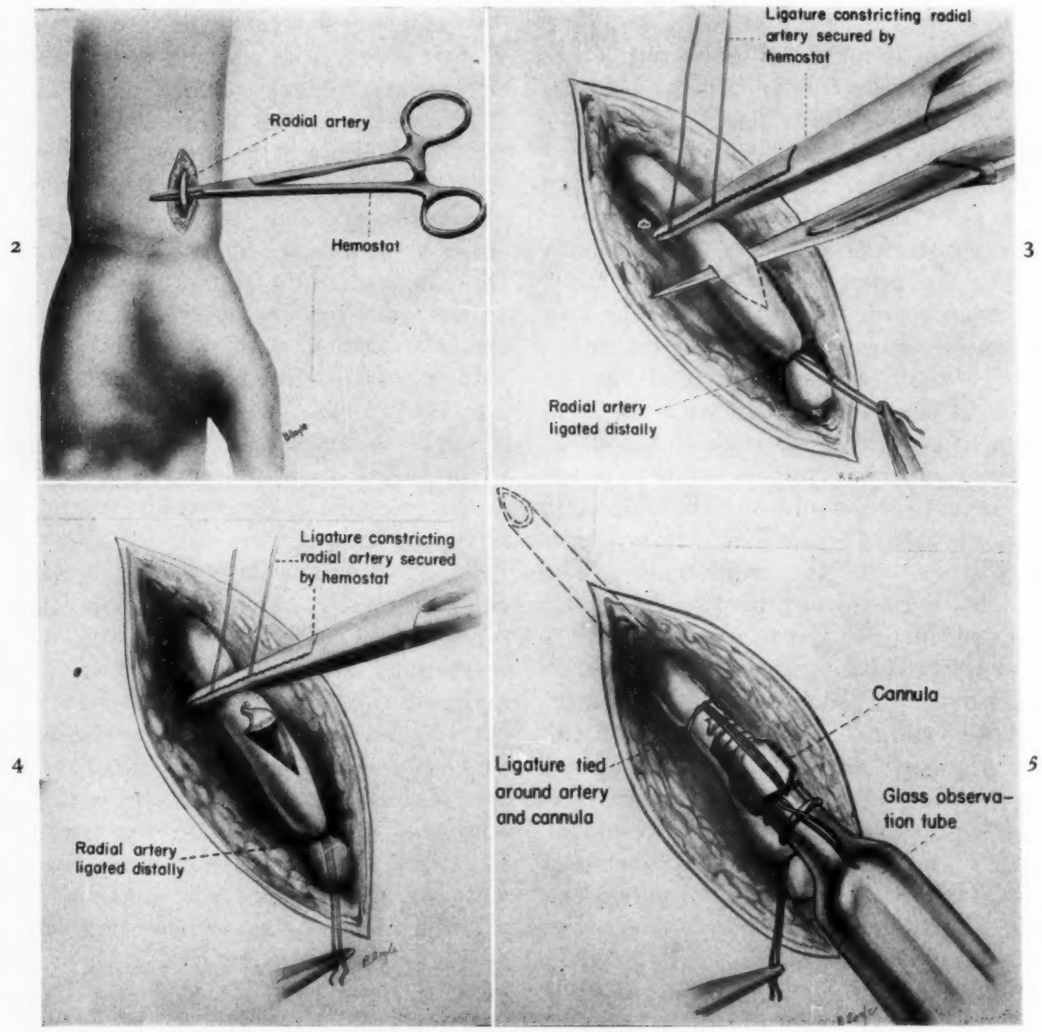

FIG. 2. Radial artery exposed over hemostat.
FIG. 3. Method of incising radial artery.
FIG. 4. Radial artery showing three-cornered incision.
FIG. 5. Cannula tied in radial artery.

the full one and the bleeding is allowed to continue. At intervals during the bleeding the direct radial arterial tension is checked as follows, namely, a sufficient quantity of the heparin solution 2 to 3 cc. is injected into the tubing system to raise the hand on the dial to about 200 mm. of mercury, then the bleeding tube is temporarily occluded either between thumb and forefinger or with a clamp, and the clamp is removed on the supply tube proximal to the manometer. This allows the heparin solution which is under pressure to flow into the radial artery and the tension in the radial artery to be registered on the manometer dial. After this reading the supply tubing is again clamped, the bleeding tube is released and the bleeding continues. During the time that the cannula is in place the blood pressure readings are taken only from the manometer dial in the apparatus and not from a stethoscope and cuff on the arm of the patient. These values are recorded on the anesthesia chart and are appropriately marked so that they may be distinguished from the readings taken in the conventional manner. Blood pressure readings thus taken are recorded every two or three

minutes and more frequently as the blood pressure falls. Bleeding continues until the blood pressure has fallen to a predetermined level, usually 80 mm. Hg. In hypertensives a higher systolic level must be kept as a minimum. Thus a patient having a preoperative systolic pressure of 175 mm. of mercury would be bled only until the pressure fell not lower than 100 mm. Hg.

When the blood pressure has fallen to the predetermined level, pressure is exerted on the radial artery proximal to the cannula in order to obstruct it whereupon sufficient of the heparin solution is injected through the bleeding tube to flush out the blood so that no clotting can occur in this part of the apparatus. During this period the clamp on the supply tube between the manometer and the Y cannula is removed and arterial blood pressures can be read continuously. During this interval, also, 3 cc. quantities of heparin are injected every five minutes. As the heparin is injected the hand on the dial registers a higher reading which immediately falls again to the accurate systolic pressure reading as the solution passes into the artery.

As soon as the first unit of blood has been withdrawn it is filtered and returned to the Kelly flask and is held in readiness for immediate return to the patient in case of need.

As long as the need for hemostasis in the operative field persists the pressure is kept at about 80 mm. of mercury. If pressure rises above this but the bleeding in the field is not troublesome, no further blood is withdrawn. If, however, concomitant with a rise in blood pressure there is increased bleeding in the operative field, additional quantities of blood are withdrawn until the blood pressure again falls to 80 mm. or until the field is satisfactorily dry.

Throughout the period during which the drawn blood remains outside the body the blood pressure is watched minute by minute with extreme care, any alterations being noted. If there is evidence that the compensating mechanisms of the body are about to fail as shown by a gradual or sudden fall in blood pressure, blood is returned to the patient from the Kelly flask until a satisfactory level has been reestablished. This is accomplished by clamping the supply tube between the cannula and manometer and forcing air into the Kelly flask until the manometer reads 200 mm. Hg. This 200 mm. Hg is a fairly accurate measure of the pressure in the Kelly flask and indicates that the blood will pass readily into the artery. The clamp is then removed on the supply tube and the blood flows through the cannula into the radial artery and upward toward the aorta. As the blood is flowing the manometer does not read either a true arterial tension nor the tension in the Kelly flask but something between. Frequent readings of arterial pressure are taken, however, by momentarily clamping the length of tube between the manometer and the Kelly flask.

It is possible in three or four minutes to restore a falling blood pressure by this means. When the base pressure has again been achieved, the infusion is interrupted and the blood pressure is followed as before. Thus by additional bloodletting or by the return of blood from the Kelly flask to the patient it is possible to keep the blood pressure at any desired level.

At the conclusion of the need for hypotension blood which has been withdrawn is returned to the patient through the radial artery. In the event that a considerable quantity of blood, that is, 2,500 or 3,000 cc. has remained outside the body for a period of thirty to forty-five minutes, it may be impossible to return all this blood without overburdening the heart owing to the fact that the circulatory volume has, in part, been made up by tissue fluids which have passed from the tissues into the vascular system. Under these circumstances the last unit of blood may be withheld and either given the following day as a transfusion or not used at all as circumstances dictate.

At times it is necessary to make certain adjustments in the position of the glass cannula in order to maintain a satisfactory

flow. Thus the cannula may be moved from side to side, elevated or depressed and held in this position by means of appropriately placed sponges.

In the event that a clot should form in the radial artery or in the cannula it is necessary to cut the suture which holds the cannula in the artery, remove the cannula, force out the clot either from the cannula or from the radial artery and again insert the cannula into the vessel as before. It is, of course, of the utmost importance that the cannula be patent so that a means of immediately raising arterial tension be available throughout the period when the maximum quantity of blood has been withdrawn owing to the fact that a sudden drop in blood pressure may occur.

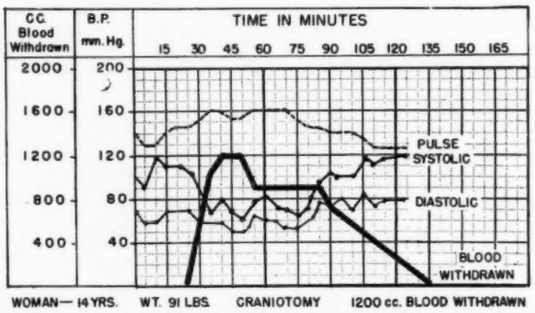

FIG. 6. Case 1. Anesthesia chart; frontal craniectomy for osteomyelitis of skull. The heavy line indicates the amount of blood in the reservoir.

After the blood has been returned to the patient the cannula is withdrawn. The artery is ligated if it is certain that the extremity will not suffer from the loss of this vessel. In case of doubt the incision in the artery should be sutured using five-zero or seven-zero silk on an atraumatic needle. If it is decided beforehand that the artery should be sutured at the end of the procedure, it is wise to use a longitudinal rather than a triangular incision in the wall of the vessel.

It is not necessary to lower the patient's blood pressure to a dangerous level in order to obtain a definite hemostatic effect. The first response to bloodletting is a generalized compensatory vasoconstriction and as the blood volume is further reduced there results a fall in blood pressure. Page[7] has shown that the initial peripheral vasoconstriction following the removal of blood is neurogenic. The persistence of vasoconstriction thereafter is due to the appearance of an ultrafiltrable substance in the circulating blood. This substance causes vasoconstriction when perfused through the isolated rabbit's ear. These two factors, therefore, are responsible for the hemostatic effect of bloodletting, namely, peripheral vasoconstriction and lowering of blood pressure.

The following cases illustrate use of this technic.

CASE REPORTS

CASE 1. A girl aged fourteen had left frontal osteomyelitis of ten weeks' duration secondary to acute left frontal sinusitis. In the operative treatment of such patients there is always serious blood loss from the engorged tissues and because of the presence of infection some of the usual measures of hemostasis, such as hemostatic clips, bone wax and electrocautery, must be used sparingly. In order to reduce blood loss in this case the procedure of controlled hypotension was used. This patient is the youngest patient on whom the method has been used.

Prior to operation the blood count disclosed 3,650,000 red cells, 8,450 white cells and 10.5 gm. hemoglobin. Operation was performed under pentothal anesthesia on February 13, 1947. A curved flap of scalp was reflected from the left frontal region, evacuating a subperiosteal abscess. A needle was introduced into the radial artery while the skull was being exposed and 1,200 cc. of arterial blood was rapidly removed. The effect on the blood pressure and pulse is shown in the accompanying chart. (Fig. 6.) Hemostasis during operation was accomplished with ease despite the great vascularity of bone and dura.

The greater portion of the left frontal bone was removed with a rongeur including the upper two-thirds of the left frontal sinus. A large extradural abscess was evacuated. Pus and granulation tissue were removed from the left frontal sinus after which a piece of gelfoam soaked in thrombin solution was placed in the nasofrontal duct to separate the nasal cavity from the operative site. Granulations were curetted from the outer surface of the dura and the inner surface of the scalp.

The cranial defect was then closed by means of a tantalum implant during which procedure the blood was returned to the patient. Sulfanilamide and penicillin were introduced into the wound which was then closed tightly without drainage by means of a single buried tier of interrupted black silk sutures in the galea.[8]

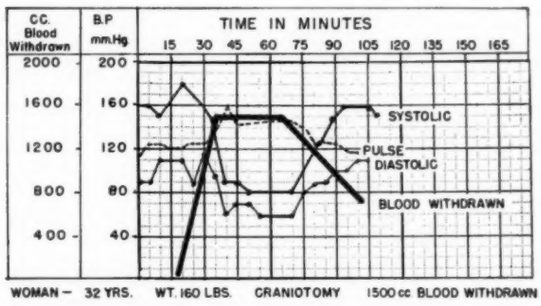

FIG. 7. Case II. Anesthesia chart; left frontal craniotomy for meningioma. All of the blood was not returned during operation because the condition of the patient did not require it.

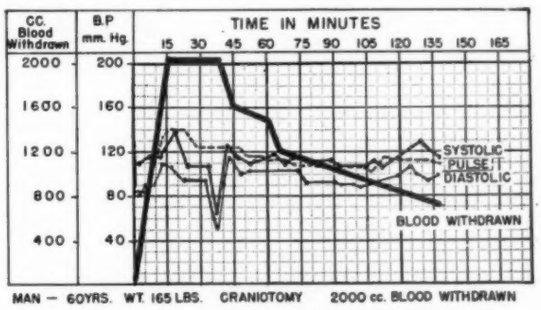

FIG. 8. Case III. Anesthesia chart; operation for recurrent parasagittal meningioma. All of the blood was not returned during operation because the condition of the patient did not require it.

The time required for the operation was two hours. At the end of the procedure the patient's condition was excellent. Following operation she was given sulfadiazine orally, 50,000 units of penicillin intramuscularly every three hours and a similar dose beneath the scalp at the operative site once a day for nine days after operation. The wound healed by primary union.

On the first postoperative day a blood count disclosed 3,140,000 red cells, 10,750 white cells and 9.0 gm. hemoglobin. The patient was given an intravenous blood transfusion of 500 cc. On the seventh postoperative day the blood count was 4,030,000 red cells, 7550 white cells and 11.5 gm. hemoglobin.

Culture of the pus revealed a non-hemolytic streptococcus which was penicillin sensitive. Convalescence was satisfactory and the patient was discharged from the hospital on the thirteenth postoperative day. When last seen four months after operation she was in excellent health.

CASE II. A moderately obese woman aged thirty-two had symptoms and roentgenologic findings indicating a meningioma of the left frontal region involving the bone. The blood pressure was 150 systolic, 100 diastolic and hemoglobin before operation was 12.8 gm.

Operation was performed on April 24, 1947. Because of the vascularity of the bone disclosed by the roentgenograms controlled hypotension was used to reduce bleeding during the operation. While the flap of the scalp was being reflected, a cannula was introduced into the radial artery and 1,500 cc. of blood were rapidly withdrawn. The effect of this procedure is shown on the accompanying chart. (Fig. 7.) As the section of bone was elevated it was found that the tumor had extended through the dura into the bone. The dura was opened widely and a meningioma was removed from the convexity of the brain. The growth weighed 120 gm. The extirpation was readily accomplished with little loss of blood. A few bleeding points in the tumor bed were controlled by electrocoagulation and the application of the three pledgets of gelfoam moistened with thrombin solution. Eight hundred cubic centimeters of blood were then returned by infusion into the radial artery; and when no further bleeding occurred, the wound was closed.

The operation was concluded in one hour and forty-five minutes. It was the surgeon's impression that the duration of the operation was shortened and loss of blood was greatly diminished by the procedure. The remaining 700 cc. of blood was reinfused by slow intravenous drip after the patient had returned to the ward. Convalescence was satisfactory and she was discharged from the hospital on the thirteenth postoperative day.

CASE III. A man aged sixty had a recurrent left frontal parasagittal meningioma which had extended through the bone and caused a large soft tissue tumor beneath the scalp. He weighed 160 pounds.

Operation was performed on August 6, 1946. Under pentothal anesthesia a cannula was inserted into the radial artery; and while the scalp flap was being reflected, 2,000 cc. of

arterial blood were withdrawn. The effect of withdrawal is shown on the accompanying chart. (Fig. 8.) The soft tissue tumor was dissected from the inner surface of the scalp flap. The involved bone was removed with a rongeur and a large, recurrent parasagittal meningioma was removed from the intracranial cavity. Bleeding during the procedure was not troublesome and was controlled by means of electrocautery, the application of one or two hemostatic clips and the use of gelfoam saturated with thrombin solution. After 1,000 cc. of the blood had been reinfused into the artery, there was some bleeding from the tumor bed but this was controlled readily by electrocauterization The cranial defect was closed with a tantalum implant and the wound was closed with a single buried tier of interrupted black silk sutures. The blood remaining in the flask was reinfused by slow intravenous drip after the patient had returned to the ward.

The condition of the patient at the end of the procedure was excellent. A blood count on the fourteenth postoperative day revealed 3,610,000 red cells, 10,850 white cells and 10.8 gm. hemoglobin. The blood count before operation was not recorded. This patient was the oldest on whom the procedure has been used.

Up to the present time at the Cleveland Clinic this procedure of arterial bloodletting and reinfusion has been used in the course of fifty operations. The average amount of blood removed is 1,700 cc. In the usual procedure the patient is anesthetized with intravenous pentothal sodium and the arterial cannula is inserted into the radial artery. When the stage of the operation is reached in which the hemostatic effect is desired, the blood is allowed to flow rapidly into a series of donor's flasks. When the systolic pressure has been reduced to 100 mm. Hg, the bleeding is stopped for a few moments and the hemostatic effect on the operative field is observed. If a more pronounced hemostatic effect is desired, the bleeding is continued until the systolic pressure is 90 or 80 mm. Hg. In some cases the pressure has been lowered to 70 systolic for a short period of time. The level to which the pressure can be safely lowered, of course, is dependent upon the patient's normal blood pressure and the state of his vascular tree. As a result of the arterial bleeding hemostasis can be readily obtained in the operative field by the usual methods of ligation, hemostatic clips, electrocoagulation, the application of absorbable cellulose, gelfoam, thrombin and bone wax.

Toward the end of the operation after hemostasis has been effected and with the operative field still exposed, the surgeon requests the anesthetist to return the blood pressure to the preoperative level. This is readily accomplished in a few minutes by the intra-arterial reinfusion of the patient's blood. Bleeding does not often recur in the operative field as the blood is returned; but when it does, it appears from one vessel at a time so that it can be readily dealt with. After the patient's blood pressure has been restored to the preoperative level, the wound is closed, the arterial cannula is removed and the remainder of the patient's blood is returned to him by the usual intravenous drip method after he has been returned to his bed. If there has been no significant blood loss during the operation, it is not necessary nor advisable to return all the removed blood for the reason that during the period of time in which the patient's blood is outside his body some restoration of the diminished blood volume occurs by the passage of tissue fluids into the blood stream. Therefore, if all the patient's blood is returned to him, he may then have a larger blood volume than that with which he started.

In this series of fifty cases the average time in which the patient's blood remained outside his body was between thirty and forty minutes. In none of these cases was it necessary to resort to the transfusion of a donor's blood during the operation. There were no accidents or untoward results which could be attributed to the procedure. The patient's convalescence has been smoother, doubtless due to the fact that operating time is shortened and trauma incident to efforts at hemostasis is lessened so that shock is avoided. At the end of the

procedure the patient's own blood is restored to him instead of replacing it by the blood of one or several donors. It is our belief that a patient's own blood is better for him than that of even a completely matched donor. If the reverse were true, then it must constitute the only instance in which homologous tissue is as completely acceptable to the host as autologous. When the blood of several donors is required to restore the patient's blood volume, the chances of subclinical or unrecognized transfusion reactions must mount rapidly.[9] Even though each donor's blood is routinely cross-matched with the recipient's it is not often feasible to cross-match the blood of several donors each with the other.

The procedure of arterial bloodletting and reinfusion has made for itself a definite place in surgery and has contributed considerably to the safety of certain types of operations. It is not a procedure to be used indiscriminately but only in selected cases in which the advantages to be gained justify the employment of the technic. It would not be justifiable in operations on the extremities when the tourniquet technic of hemostasis may be used. It would seldom be indicated in intra-abdominal operations in which the application of hemostats and ligatures is so readily effected. It should be used with great caution in any operative procedure carried out with the patient in the erect position because with the head high relative cerebral ischemia results from a lowering of blood pressure. Its greatest field of applicability is in cranial surgery. It has been used with success to reduce the troublesome bleeding encountered in the fenestration operation.[10,11] It may prove to be of value in certain intrathoracic operations.

In a patient with coronary arteriosclerosis the lowering of blood pressure by this procedure might precipitate occlusion. Conversely, however, the preoperative insertion of an arterial cannula in such a case to maintain blood pressure in case of sudden loss of blood from the operative field might, by preventing slowing of the coronary circulation, prove to be a lifesaving measure.

A simple pressurized system for rapid arterial transfusion (Fig. 9) should be available in every emergency ward and operating room since in the treatment of severe hemorrhagic shock the arterial route is two and one-half times as effective as the intravenous route.[11]

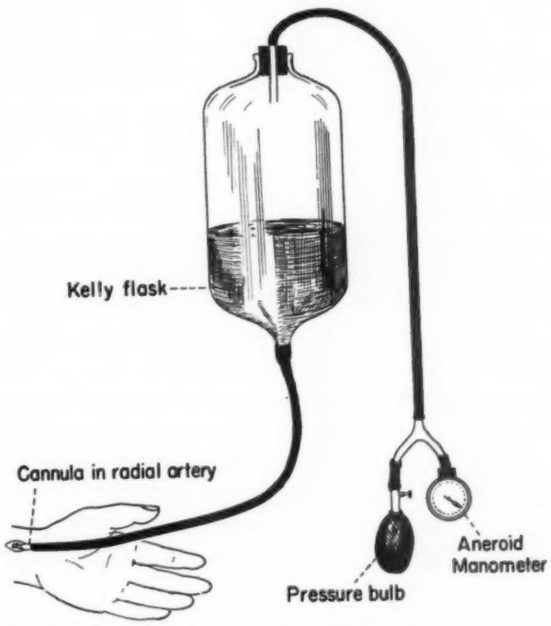

FIG. 9. Apparatus for administration of arterial infusion.

CONCLUSION

Arterial bloodletting during operation is an aid in hemostasis. The procedure followed by the intra-arterial injection of the removed blood at the end of the operation provides a margin of safety in certain cases which is not available by any other means.

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It is not definitely decided whether Ewing's tumor represents a neoplastic disease or simply an unusual, inflammatory one. For that reason and because diagnostic x-rays are not always diagnostic enough to make one entirely certain of this particular diagnosis, it seems advisable to make a rule that no suspected case of Ewing's tumor be treated as such (either by amputation, radiotherapy or both) until a biopsy has first been done and the diagnosis definitely established. One recent author reports on twenty cases of Ewing's tumor and cites that apparent pulmonary metastases may disappear after direct treatment to the primary focus itself—a fact, if confirmed, that is remindful of similar behavior on the part of pulmonary metastases after adequate removal of the primary growth in cases of chorionepithelioma. (*Richard A. Leonardo, M.D.*)

ADDISON'S DISEASE AND PREGNANCY*

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THIS presentation consists of a review of thirty-nine cases[1–31] of Addison's disease and pregnancy reported in the literature from 1859 to 1946 together with a case report from the Long Island College Hospital. The cases included in this review have been divided into three groups as follows: *Group* I. Addison's disease complicated by pregnancy, the diagnosis of Addison's disease having been made before the onset of pregnancy, nineteen cases. *Group* II. Pregnancy complicated by Addison's disease in which Addison's disease developed during the pregnancy or puerperium, sixteen cases. *Group* III. Pregnancy and Addison's disease, the relationship between the onset of Addison's disease and pregnancy having been unknown, five cases.

Etiology. According to Thorn's observation[26] the etiology of Addison's disease is non-tuberculous in 70 per cent of all patients afflicted. Of the forty patients included in this study eighteen died and ten were subjected to autopsy. Necropsy findings in the latter showed tuberculosis of the adrenals in eight instances, atrophy of the adrenals in another and lues in the remaining one. Of the other eight fatal cases which were not subjected to autopsy, two patients gave a history of tuberculosis and one had Bacillus coli septicemia. The histories of the remaining five patients were incomplete in this respect. The histories of the twenty-two patients who survived mentioned malaria, influenza, abortion with hemorrhage and puerperal infection as etiologic factors in seven instances. No definite etiology was revealed in the reports of the other fifteen. The reports of the patients who survived pregnancy failed to show known tuberculosis of the adrenals.

Age. The average age of women in this series was twenty-nine years while that of all women with Addison's disease has been quoted as forty.[26] The combination of Addison's disease and pregnancy has been rare because most of the women so affected are beyond the child-bearing period. In former times the patients in the younger age group died because of inadequate therapy or because of the severity of some concomitant disease. Furthermore, most of the younger women have been warned against the hazards of pregnancy and have avoided conception. It is reasonable to expect an increase in the number of patients with Addison's disease who become pregnant as more complete replacement therapy becomes available.

Parity. This study shows the cases to be equally divided between primigravida and multigravida, with no significant difference in the survival rate of each. Three patients were known to have been pregnant a second time.

Menstruation. It has been observed repeatedly that the major effect of adrenal insufficiency on ovarian function is like that of any other debilitating disease. Young women with Addison's disease who are in good general metabolic condition accordingly have no menstrual anomalies attributable to this disease. Therefore, pregnancy must be considered whenever amenorrhea occurs.

Abortion. In the forty cases reviewed in this presentation seven instances of abortion were noted. Spontaneous early abortion, although noted frequently in adrenalectomized animals,[34,52] was not ob-

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served in any of the reports included in this study. This observation would seem to indicate that spontaneous early abortion is not of common occurrence when a woman with Addison's disease becomes pregnant. Eng[23] reported the death of a patient which tends to substantiate this impression. His patient was a young woman with well regulated Addison's disease who died in the course of an exacerbation. At autopsy an intact pregnancy of eight weeks' duration was found.

Abortion was induced in the early months in three treated patients, one of whom died. Death, however, was due to B. coli septicemia which followed the accidential perforation of the uterus. Two other patients upon whom early abortions were performed had fairly severe cases of Addison's disease; they were probably given inadequate hormone therapy and failed to respond favorably. It is possible that with our present methods of therapy, abortion would not have been considered.

Since any major operative procedure on patients suffering from Addison's disease may cause their death, pregnant women who have marked contraction of the pelvis or some other indication for cesarean section might well be aborted until further complete replacement therapy becomes available. Such an abortion should be done before the twelfth week when the operation can be easily performed under local anesthesia with minimum sedation and adequate preoperative preparation against crisis. The postoperative course should be closely supervised and penicillin or sulfa drugs given prophylactically.

If Addison's disease responds to adequate medical therapy, the pregnancy probably will be well tolerated and therapeutic abortion need not be considered. When the disease does not respond to treatment, therapeutic abortion might do more harm than good. It is possible that therapeutic abortion would be of no benefit and that the risk of this minor operative procedure would only aggravate the condition. In this connection it may be said that termination of pregnancy after the third month by means of x-ray therapy, is an uncertain procedure.[32] When successful, the fetus may be retained as long as fifty days. In addition the temporary sterilizing effects of the rays by interfering with the production of the sex hormones may indirectly add to disturbed salt metabolism.[33,35–38]

Late induction of abortion was resorted to in three cases in which all patients died, as might be expected since late induction of abortion is a formidable procedure. A high incidence of unfavorable outcomes must be expected in such cases.

Prematurity. There were two cases of premature delivery in which Addison's disease was manifested for the first time during the pregnancy. Both patients died and both had tuberculous involvement of the adrenal glands. One had therapy of questionable value and the other was adequately treated. These cases show that the increased adrenal function demanded by pregnancy accelerates and makes adrenal cortical exhaustion evident. They also show that the fetal adrenals, on the other hand, did not play any significant role since both patients became progressively worse as pregnancy advanced. Spontaneous termination of pregnancy at any time before term and the artificial interruption after the third month and before term carried with it a 100 per cent mortality in the series of cases reviewed.

SIGNS AND SYMPTOMS

The most commonly encountered signs and symptoms of Addison's disease in pregnancy will be reviewed briefly.

Asthenia is a characteristic symptom. Pigmentation becomes intensified and usually remains after the termination of pregnancy. Gastrointestinal symptoms which are common in both conditions tend to mask the existence of one complication in the presence of the other. Gastrointestinal symptoms in Addison's disease frequently denote an impending crisis. Weight loss is associated with these symptoms and serves

as a rough guide to therapy. Blood pressure varies from normal low to low levels depending on the patient's condition and the therapy used.

Although hypoglycemic episodes occur as a major hazard in the treatment of 25 to 50 per cent of all patients with Addison's disease,[39,40] no hypoglycemic episodes were encountered in the present series. This possibility, however, must be kept in mind during the first trimester as well as after delivery or operative intervention. The mechanism, which in the normal pregnant woman causes a prolongation of the glucose tolerance curve in the second and third trimester, may be a factor in the prevention of such episodes at that time.[41,42] The glucocorticoids are given to prevent the possible occurrence of this accident during pregnancy.

Hypothermia or hyperthermia occurs in crisis. When hyperthermia is associated with crisis, it is a very bad omen.[43] It is most frequently encountered during the second and third postpartum days and may also be due to infection.

Crisis is a major hazard and usually is accompanied by vasomotor collapse. Vasomotor collapse and death, however, may occur in the presence of perfectly normal blood electrolyte levels and, perhaps, may be due to some adrenal cortical factor not yet isolated. It is most frequently encountered during the puerperium. The stress and strain of labor and the blood loss coupled with the cessation of fetal adrenal secretion and a decrease in the titer of the circulating sex hormones[48] may possibly be the reason for the development of crisis during this period. Addison's disease was suspected and diagnosed for the first time in seven patients after they developed crisis during the puerperium. In each case the fatigue pigmentation and gastrointestinal symptoms had been attributed to the pregnancy.

Of the twenty-two full term pregnancies in this series, twelve patients developed crises after delivery and seven of them died (six were untreated and the other had questionable therapy). Five of the seven patients who died were in the group in which the diagnosis of Addison's disease was made after pregnancy occurred (Group II).

Preparation for crisis should precede

TABLE I

	Group I				Group II				Group III			
	Treated		Untreated		Treated		Untreated		Treated		Untreated	
	Lived	Died	Lived	Died	Lived	Died	Lived	Died	Lived	Died	Lived	Died
First trimester	1	1										
Second trimester	..	1*	..	2	..	..	..	1				
Third trimester	..	..	..	..	1	1†						
Delivery												
Early puerperium	2	..	..	1	4	1†	..	..	..	..	..	2
Late puerperium	..	1	..	..	..	..	..	4				

Total deaths in crisis ..... 14 (10 of whom were untreated)
1 our patient
1 B. coli septicemia
2 unknown

Total deaths 18

* Questionable therapy
† Same case

delivery by approximately forty-eight hours and the various therapeutic aids available for its treatment should be at hand after the delivery.

Many cases have been but briefly described and crisis may have been present but not mentioned by the author. Table I shows the occurrence of crisis when mentioned.

OBSERVATIONS DURING LABOR AND PUERPERIUM

Our observations indicate that Addison's disease does not influence labor. This is inconsistent with the theory that the adynamia in this disease involves the smooth as well as striated muscle. Patients with Addison's disease are very susceptible to barbiturates and morphine, hence, sedation should be kept to a minimum at all times. Adequate salt and sugar intake should be maintained during labor and whole adrenal cortical extract, glucocorticoids and desoxycorticosterone should be administered as necessary. Desoxycorticosterone is of very little value in the treatment of crisis.

Local anesthesia is indicated for the delivery. The second stage of labor must be shortened as much as possible, with the use of low forceps if necessary, as the patient should be spared the strain of bearing down. Spinal and general anesthesia are poorly tolerated and are not to be used. The third stage of labor is apparently unaffected by Addison's disease.

Lactation rarely occurs but if it does it should be suppressed. One author mentions "lactation crisis."[16] He was of the opinion that crisis was brought on by lactation.

MATERNAL MORTALITY

Barring concomitant infection, the life expectancy of a patient with Addison's disease of tuberculous origin is equal to that of the patient with Addison's disease in which there is adrenal cortical atrophy.[44] The apparent increased mortality rate in the pregnant tuberculous group was directly related to the severity of the tuberculous process elsewhere in the body and to the therapy used.

Temporary adrenal insufficiency such as that which may be encountered in puerperal sepsis[43] may be followed by complete recovery; otherwise, the prognosis of Addison's disease is grave and pregnancy is an additional hazard. The outcome in a patient with Addison's disease who becomes pregnant should be favorable if she is allowed to go to term with adequate therapy and if delivery from below can be anticipated. When more complete replacement therapy becomes available, surgical procedures probably will be tolerated with less risk than at present. Patients may succumb to overtreatment with salt and desoxycorticosterone.[45] The fatal outcome in such cases is attributed to the effects of hypertension, cardiac failure or potassium deficiency.

While it would seem that therapeutic abortion performed early in pregnancy might decrease the maternal mortality in patients who respond to medical therapy, the maternal mortality is low in treated patients who reach term and deliver spontaneously. Addison's disease, therefore, need no longer be considered an absolute contraindication to pregnancy. This assumption is substantiated in a measure by the mortality record shown in Table II.

TABLE II
FULL TERM PREGNANCIES

	Group I	Group II	Group III	
Treated living.....	4	5	0	9
Treated dead.....	2*	..	..	2
Untreated living ...	3	0	2	5
Untreated dead.....	1	3	2	6
				Total 22

* One was our patient and the other had questionable therapy.

FETAL PROGNOSIS

The fetal prognosis is fairly good, especially if the pregnancy goes to term. Twenty-

two of the patients included in this review carried their pregnancies to term and all but one gave birth to living children. However, two infants died of gastrointestinal disturbances within the neonatal period. Their deaths in all probability were not caused by the mother's condition. The stillbirth also was not associated with the mother's disease since autopsy showed lues. Two mothers delivered prematurely although both children were born alive; one died shortly after birth.

It is postulated that the release of immune bodies may be a function of the adrenal corticoids.[47] As a consequence, the fetus born of women with Addison's disease should have a lowered resistance to infection unless the fetal adrenals exercise some effective influence on the maternal organism. Babies born of women with untreated Addison's disease in this series, however, fared as well as those born to normal mothers.

CASE REPORT

Mrs. A. V., aged thirty-one, para 1, gravida 2, was admitted to the Long Island College Hospital in September, 1945. She gave a history of having had tuberculosis of the right hip. She was operated upon for this condition and was discharged as cured in 1933. In 1937 she again was subjected to operation for tuberculosis of the right clavicle and again was discharged as cured. At the end of a full term pregnancy in 1940 a cesarean section was performed for cephalopelvic disproportion. The baby weighed 7 pounds and 2 ounces. The mother's postoperative course was normal. In 1942 the patient began to have right upper quadrant pain, weight loss, increased pigmentation with marked fatigue and anorexia. Gallbladder disease was diagnosed and she was placed upon a special diet. Four months prior to her last admission she was sent to the hospital because of a condition which was diagnosed as an acute gallbladder attack. The attending surgeon, however, made the diagnosis of Addison's disease and transferred her to the medical service of the Long Island College Hospital where the diagnosis was confirmed. After a month's therapy with salt and desoxycorticosterone, she was discharged with a 225 mg. pellet of desoxycorticosterone implanted in the right subscapular region. Although the patient had skipped a menstrual period, pregnancy was not suspected at the time of her discharge on October 21, 1945.

She appeared at the obstetric clinic on January 14, 1946, and gave a history of having had constant nausea and vomiting since leaving the hospital. Examination showed her to be four and a half months pregnant. It might be stated parenthetically that our patient clearly showed how the gastrointestinal symptoms of Addison's disease may mask those of pregnancy. On February 1, 1946, the patient was admitted to the hospital for further observation and therapy because of persistent nausea and vomiting.[49]

The following criteria were used as guides to therapy: weight, blood pressure, heart size, electrocardiogram, hematocrit, gastrointestinal symptoms, edema, blood chemistry. An attempt was made to prevent crisis, hypoglycemic episodes and infection. The available therapeutic measures employed were salt, glucocorticoids, desoxycorticosterone, a high caloric diet and vitamins and iron. The patient was closely observed for signs of desoxycorticosterone overdosage such as transient edema, hypertension, cardiac insufficiency, muscular contractions or transient paralysis.

The patient's course was relatively smooth until after her operation which was performed on May 16, 1946. The blood pressure remained more or less stationary and the gastrointestinal symptoms were relieved. She was a somewhat fussy, tempermental eater and frequently partook of Pepsi-Cola rather than food. Late evening nourishment was encouraged to offset the possibility of morning hypoglycemia. However, the morning weakness and dizziness which she experienced occasionally did not appear to be related to the blood sugar level but to the blood pressure changes. The blood sugar was maintained at a low level throughout the second and third trimester. Glucocorticoids were given to prevent the possible occurrence of hypoglycemic episodes. None occurred nor was any readjustment of dosage of hormone required during the second and third trimester as perhaps would be expected.[50]

Transient edema was present once during the sixth month but disappeared after desoxycorticosterone was decreased for several days. The blood chemistry was not unusual at any time.

Edema, hypertension and albuminuria may occur with an overdosage of desoxycorticosterone and with toxemia of pregnancy. It would be difficult to distinguish between them unless a marked alteration in the blood chemistry was present. A decrease or the omission of desoxycorticosterone for several days should eliminate edema and hypertension if such effects were the results of overdosage with desoxycorticosterone. This, of course, would be impossible if the desoxycorticosterone had been implanted in the form of pellets. A decrease in salt intake would correct edema but would not necessarily reduce the hypertension caused by desoxycorticosterone. At best, unless the pellet were removed, it would be difficult to determine the etiology of hypertension, edema or albuminuria in the latter half of pregnancy. Theoretically, less desoxycorticosterone should be required in the second and third trimester because of the fetal adrenal and the high levels of the circulating sex hormones.[50] This was not apparent in our patient. No patient in the series reviewed developed toxemia of pregnancy.

Prophylactic preparation for crisis was begun two days preoperatively. Inadvertently, twice the amount of desoxycorticosterone was given to the patient than had been ordered. The patient was delivered of a living female child (2,540 Gm.) by cesarean section performed in the thirty-sixth week of pregnancy under local anesthesia. This was considered the optimum time for operation because the circulating blood volume is greatest at that time and the circulating sex hormones are at their highest level.

The patient developed slight edema accompanied by an elevation of blood pressure on the first day after operation. Desoxycorticosterone was discontinued. A Miller-Abbott tube was introduced on the second postoperative day as paralytic ileus developed in the patient at that time. Glucose and saline infusions were slowly and constantly given but the only potassium administered was that contained in two pints of blood and plasma. The hypertension was considered to be the specific effect of desoxycorticosterone.

Penicillin was given prophylactically on the day of operation and sedation was at all times kept at a minimum. Because of the ileus, the patient was unable to take food by mouth until the third postoperative day at which time she requested Pepsi-Cola and toast and appeared to be markedly improved. The patient's temperature rose to 104.8°F. on the afternoon of the third postoperative day and she began to have gross clonic contractions of the left shoulder. The blood pressure at this time was 136/60. It remained at this level up to one hour before death on the morning of the fourth postoperative day when it declined rapidly. The temperature remained high. Generalized twitching of the facial muscles with intermittent clonus of the right shoulder and left leg occurred an hour prior to death when the patient also became comatose. She expired with a violent contraction of the muscles of the anterior abdominal wall.

Autopsy findings showed caseation necrosis of the adrenals with no normal adrenal tissue discernible. No evidence of acute infection or tuberculosis was observed in the lungs. The heart was small; microscopically, it did not reveal anything characteristic of a low potassium effect.[51] The pathologist's report was death by adrenal insufficiency with inadequate reaction of the body to trauma. Clinically, the possibility of death due to overdosage of desoxycorticosterone was considered.

SUMMARY

1. Thirty-nine cases of Addison's disease associated with pregnancy have been reviewed and studied.

2. Another case which terminated fatally following cesarean section is reported in detail.

3. Latent Addison's disease in a woman may become active when she becomes pregnant and most commonly manifests itself during the first trimester or the puerperium.

4. This study seems to indicate that the symptoms of Addison's disease may mask those of pregnancy and vice versa.

5. Modern therapy has greatly lessened the risk of Addison's disease associated with pregnancy.

6. As a consequence of the good results

obtained with adequate therapy, Addison's disease has become a questionable indication for abortion.

7. As any type of operative intervention greatly increases the risk of the disease, therapeutic abortion may do more harm than good.

8. Pregnant patients with Addison's disease require constant observation and treatment and the need for hospitalization and careful supervision during the first trimester, delivery and the puerperium should be emphasized.

9. The therapy required in the management of these cases is expensive.

10. Spontaneous premature delivery seems to increase the risk of Addison's disease.

11. Cesarean section and other forms of operative intervention at term increase the hazards of Addison's disease.

12. Spontaneous delivery at term is followed by the best results.

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WALTERS et al. reviewed a large series of vagotomies recently performed at the Mayo Clinic and found that in many of the cases symptoms were relieved and postoperative gastric acidity was often markedly reduced. However, in a few instances complications occurred necessitating reoperation. One patient had recurrent ulceration severe enough to require subsequent partial gastric resection and in another a duodenal ulcer perforated. Such a complication can occur without pain because of the previously performed gastric neurectomy. Besides, in a large proportion of cases a definite disturbance in postoperative gastric motility occurred so that often it was difficult for the stomach to empty itself. Finally, vagotomy must still be considered an operation in the experimental stages because even with complete sectioning of the two vagi we have no positive proof that the good results of this operation are permanent. Vanzant has shown on animals that the results are often only of a temporary nature. It will be several years yet before the final word can be said on this operation. (*Richard A. Leonardo, M.D.*)

CHORIO-EPITHELIOMATOUS ELEMENTS OCCURRING IN TERATOMA OF THE TESTIS

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ACCORDING to Ewing, in 1803 Prochaska found fetal limbs and in 1833 Andre de Perione observed hair, teeth and bones in a teratoma of the testis; Waldeyer in 1868 observed a polypoid tumor comparable to a hydatid mole extending from a testicular teratoma into the pelvic veins; and a typical case of chorio-epithelioma was described by Brues in 1878 in which the polypoid masses extended into the heart.

Melicow believed that teratogenesis is a form of pathologic development during the embryologic period; that because of some unknown factor these cells become segregated, remain viable and under the right stimulus undergo development to produce the resulting tumors. He was of the opinion that the fertilized ovum can divide at the first segmentation to produce identical twins, conjoined twins, either equal or unequal, or a teratoma to a conjoined twin. In the early blastomere stage the early trophoblastic cells specialize into chorionic epithelium to nourish the embryo. These first blastomeres are totipotent and any one cell can form a new individual. If these cells become included in a developing testis or any other organ as cell rests, they have the power to multiply and form a tumor that contains embryonic-like structure and chorionic tissue. Into this group would fall malignant teratoma that contains choriomatous elements and chorio-epithelioma.

Bell stated that he believed a chorio-epithelioma to be a one-sided development of a teratoma. Hinman and Powell were of the opinion that these embryonal tumors showed all variations of differentiation from the most primitive germ cells, that is chorionic, down to cells that simulated spermatocytes.

Chorio-epitheliomatous elements are present in teratoma of the testis. Focal areas occurred in 12 per cent of the cases, reported by Friedman and Moore, of their so-called embryonal carcinomas and teratocarcinomas, these two types of carcinoma constituting 6.4 per cent of their entire series. They believed that a pure primary chorio-epithelioma is very rare (0.4 per cent in their series of 922 cases). Tumors of this type are hemorrhagic, composed of two cellular elements, the syncytial and the Langhans cells, and tend to duplicate the architecture of placental villi. Usually such tumors present much more of the cytotrophoblastic element than the syncytiotrophoblastic element. Friedman and Moore thought that Langhans cells and foreign-body giant cells were present in stroma of many seminomas. These men also believed that the recognition of the trophoblastic nature of many of their so-called embryonal carcinomas and teratocarcinomas makes understandable the secondary endocrine changes, such as gynecomastia, in these cases. Ewing was of the opinion that it is hazardous to make the diagnosis of chorio-epithelioma of the testis in the absence of hepatic or pulmonary metastasis, because no gross chorion-like structures have been identified in the testis and similar cells may appear in tumors which have not yielded

chorio-epitheliomatous metastatic lesions. Hinman and Powell were of the opinion that the presence of primitive syncytial cells is the characteristic thing about a chorio-epithelioma. The gynecomastia associated with these tumors is characterized by an increase and enlargement of the larger ducts suggestive of secretion. Gilbert was of the opinion that the hypophysis shows histologic changes generally described as typical of "pregnancy cells" (adenomatosis, acidophilia and basophilia), the changes being directly proportional to the amount of hormone stimulation.

Much remains to be done to correlate the types of testicular tumors with the results of hormone assay. Previously it was advocated by Belt, by Cutler and Owen, by Ferguson, by Hinman and Powell and by others, that the type of tumor could be determined by a quantitative estimation of the gonadotropic hormone in the urine. This has not proved to be true. Brewer pointed out that consideration was not given to the fact that there are two types of gonadotropic hormones and that the significance of each was not evaluated. The biologic test of Aschheim and Zondek has been reported as giving positive results both in cases of seminoma and in cases of teratoma.

Brewer and Twombly and co-workers have shown quite conclusively that there are two types of hormones which must be considered in the study of assays of the urine of patients having testicular tumors. One type is the chorionic gonadotropin and is identical with that found in the urine of pregnant women; it produces luteinization of the ovarian follicles. This hormone is almost exclusively, if not entirely, produced by the Langhans cells as shown by Jones, Gey and Gey; they did hormone assays on tissue cultures to prove this fact. The other type of hormone is the castrate type that is elaborated by the hypophysis and is found in castrates, either male or female, in women past the menopause and in old men. This hormone produces only follicular growth, and its presence signifies either a reduction or cessation of testicular function and does not in any way demonstrate the presence or absence of biologically active chorionic tissue. If there is luteinization of ovarian follicles and no gross evidence of chorionic tissue, serial sections of the tumor should be made because many of these tumors contain only microscopic chorionic tissue.

Twombly, Temple and Dean reviewed the data on Ferguson's cases and found that there was no close relation between histologic type and the rate of hormone excretion; absence of hormone excretion does not mean that tumor tissue is not present, and from a prognostic standpoint one cannot exclude metastasis because of failure to find the chorionic gonadotropic hormone in the urine. Twombly and co-workers stated that, in general, when the tumor is one of low grade, the amount of hormone tends to be low but with more malignant types, especially chorio-epithelioma, it tends to be high. He thought that the appearance of the chorionic gonadotropic hormone is a bad prognostic sign and not infrequently is the only evidence of the disease. Twombly and his group were able to show that among those patients with 1,000 mouse units or less per L. of urine the mortality rate was 33 per cent; among those with 1,000 to 2,000 mouse units per L. the mortality rate was 57 per cent; and among those with 2,500 mouse units or more the mortality rate was 82 per cent. Only a positive result is of any significance—a negative result means nothing. Another serious drawback to the test is that it is too expensive and complex to warrant its use except in large institutions.

Gilbert believed that if chorio-epitheliomatous elements are present, gynecomastia is likely to occur. Bell stated that this is true in 5 to 10 per cent of cases. Gilbert, in studying 135 cases of gynecomastic associated with testicular tumors, found that in 103 the lesion was choriogenic hyperplasia and of these, fifty-four were primary testicular chorio-epitheliomas, seven were "extragenital" chorio-epitheliomas, eleven

were apparently misdiagnosed primary tumors of the testis and thirty-one were teratoid tumors of the testis characterized by chorio-epitheliomatous metastasis. In twenty of the cases there was non-choriogenic hyperplasia. The lesions of choriogenic hyperplasia differ histologically from those showing non-choriogenic hyperplasia. In the former, there is glandular structure indicative of a true functional physiologic change, while in the latter there is a fibrous or fibro-adenomatous structure. Gilbert also stated that often associated with gynecomastia is an enlargement and pigmentation of the areola about the nipple, and hyperplasia of the prostate and seminal vesicles may occur.

The teratoid tumors tend to metastasize early, especially if very malignant structures are present. This is especially true of the chorio-epitheliomas. Chorio-epitheliomas tend to metastasize by way of the blood to the liver and lungs, and as previously stated, Ewing thought it hazardous to make the diagnosis of chorio-epithelioma in the absence of metastasis to the liver or lung. There may be chorio-epitheliomatous metastatic growths and no primary source found in the testis, but to be certain, serial sections should be made of the testis. Also, if no primary source is found, one must remember that "extragenital" chorio-epithelioma may be present. These are thought to be teratomas arising from cell rests along the line of origin and descent of the testis. Lewis and Friedman and Moore, in studying 922 cases of testicular tumor, found that 90 per cent of their so-called embryonal carcinomas metastasized as embryonal carcinoma or chorio-epithelioma and that teratoid structures were rare. Forty per cent of their so-called teratocarcinomas did the same but in 60 per cent there were frank teratoid structures in the metastatic growths. Nearly two times as many metastatic lesions revealing chorio-epitheliomatous elements arose from tumors containing no proved chorio-epithelioma as from focal or pure chorio-epithelioma. They were of the opinion that 34 per cent of all the metastatic tumors which terminated fatally contained chorio-epitheliomatous elements.

Lewis thought that the radical operation should be used in place of roentgen therapy in treating teratomas, but for undifferentiated carcinoma, embryonal carcinoma of Friedman and chorio-epithelioma he advocated radical operation plus high voltage roentgen therapy. In his series of cases he had no living patients with pure chorio-epithelioma, but twelve patients who had tumors that contained chorio-epitheliomatous elements and who had orchectomy and radical dissection of the para-aortic nodes were living two years postoperatively. Ormond reported that two out of three patients with chorio-epithelioma were living after orchectomy and high voltage roentgen therapy only. Lewis believed that 5,000 r produced by a 1,000,000 volt machine led to severe bowel symptoms and often perforation which occurred one and a half to two years after initial treatment. At the Mayo Clinic simple orchectomy and roentgen therapy are now used on all testicular tumors.

MATERIAL AND METHODS

The material which formed the basis for this study consisted of (1) 127 case records from the files of the Mayo Clinic of patients having either a teratoma or an adenocarcinoma of the testis, (2) ninety-six gross specimens of teratoma and adenocarcinoma from the medical museum of the clinic, (3) microscopic slides previously made in the study of these gross specimens (two to four slides per specimen), (4) ninety-six new and larger microscopic slides from these gross specimens and (5) microscopic slides which had been brought to the clinic for examination but which had been prepared from testes removed elsewhere.

All case records of patients with teratoma or adenocarcinoma of the testis in the files of the clinic from 1910 through 1946 were abstracted and a special note was made of any cases in which there was a high excretion of hormone or any visible endocrine change such as gynecomastia or pig-

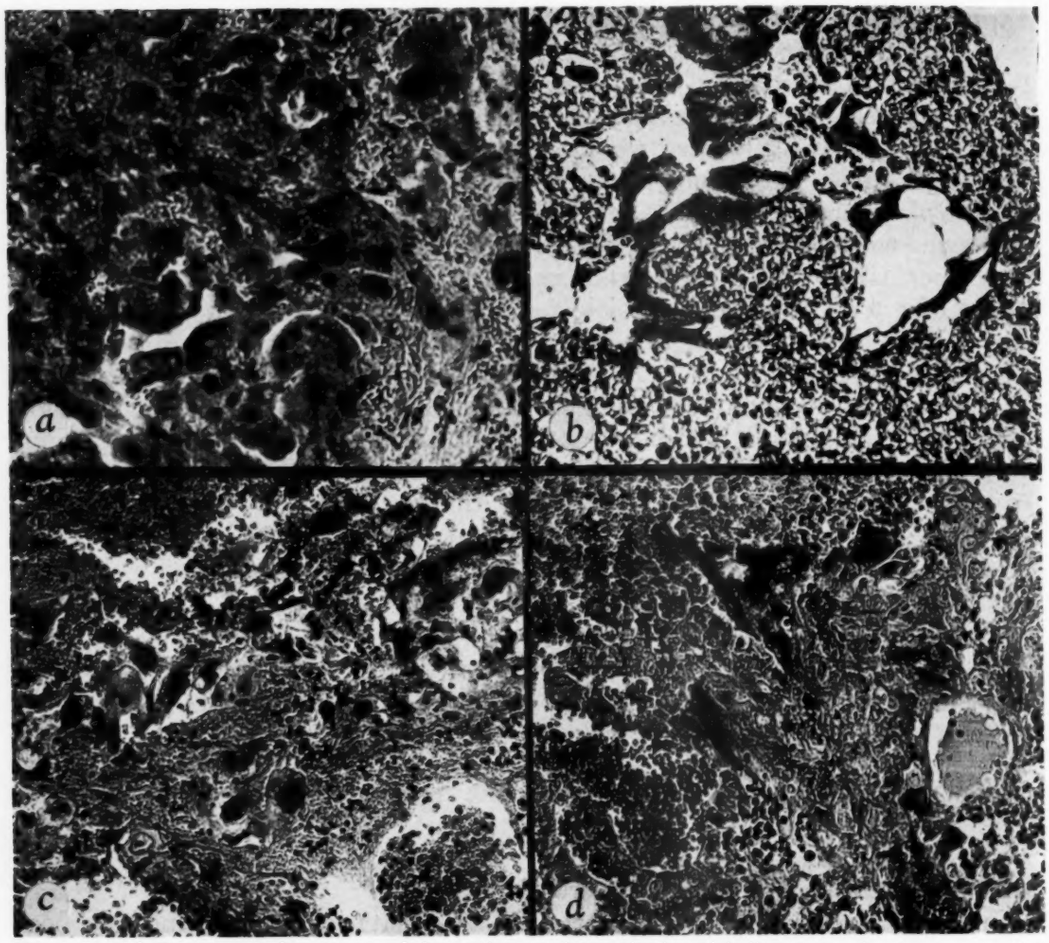

FIG. 1. *a* to *d*, Four cases of teratoma of the testis containing chorio-epitheliomatous elements; syncytial cells are prominent in each section. Hematoxylin and eosin × 175.

mentation about the areola. Study of the ninety-six gross specimens included consideration of the gross appearance, whether the tumor was cystic or solid, whether hemorrhagic or necrotic, the size of the tumor and the limitations of its growth. Tissue was removed from the areas which appeared to be the most hemorrhagic. This tissue was cut into large sections so that as great an area as possible could be examined, and from these, paraffin hematoxylin-eosin slides were made. Repeated detailed microscopic examinations were made of these slides and all of those previously collected. This examination was, for the greater part, a search for areas of necrosis and hemorrhage and for the presence of the Langhans or syncytial cells.

FINDINGS

Pathologic Aspects. There were ninety-six gross specimens of teratoma of the testis in the medical museum. The specimens were all preserved in formalin. Three of these specimens were found to contain chorio-epitheliomatous elements on microscopic examination, while in four other cases in which these elements were present there was no gross tissue for examination. Of the three specimens containing chorio-epitheliomatous elements two were solid and one was solid and cystic. Two of these specimens showed areas of pigmentation and one had an area of gross hemorrhage. The usual color was gray and very little necrosis was present on gross examination.

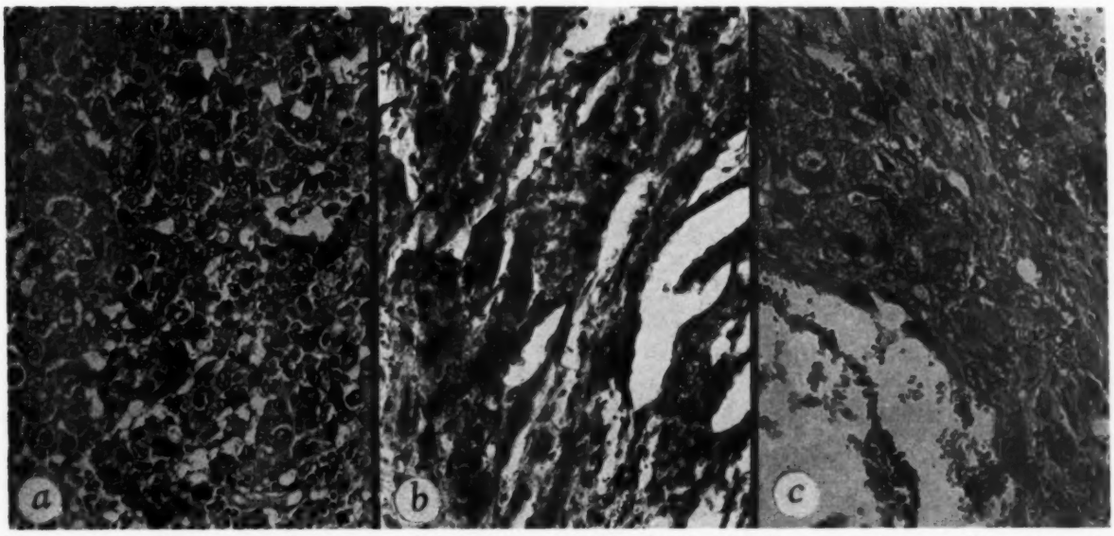

FIG. 2. *a* to *c*, Three cases of terotoma of the testis containing chorio-epitheliomatous elements. Syncytial cells are present in those sections as they were in the sections in Figure 1. No demonstrable Langhans cells are evident. Hematoxylin and eosin × 175.

Determination of the site of origin was impossible.

Microscopic Features. In the microscopic study of the available tissue a thorough and repeated search was made for areas that were necrotic and hemorrhagic for it is here that one would expect to find the trophoblastic elements that are essential to the diagnosis of chorio-epithelioma. The trophoblastic elements were considered as such when syncytial cells, Langhans cells or a combination of both were present. Typical villi were not observed. The syncytial cells were found to be large dark-staining cells with large nuclei and basophilic cytoplasm, often having continuous and joining protoplasmic extensions. They were often stellate in appearance and, in many instances, the cellular outline could not be ascertained, which gave them the appearance of giant cells. This was the appearance in all seven cases of chorio-epithelioma. (Figs. 1 and 2.) In four other cases the predominant cell appeared to be of the Langhans type; but since it could not be proved that they were really Langhans cells, they were not included although in three of the four cases there was increased excretion of hormone. These cells were round or polyhedral in outline, medium to large in size, and had a distinct central nucleus and a light-staining cytoplasm.

Clinical Data. The ages of the patients who had chorio-epitheliomas ranged from twenty to thirty-two years. Other clinical data are given in Table 1.

COMMENT AND SUMMARY

A study of 127 cases of teratoma of the testis was made in an attempt to show that chorio-epitheliomatous elements are present in these tumors. In this group of 127 cases the greatest incidence of teratoma was in the third decade, although there was a relatively high incidence in the fourth decade. The mortality rate was high, with 80 of the 127 patients dying within one year after treatment.

The incidence of chorio-epithelioma in teratoma of the testis was found to be 5.5 per cent (seven cases). No proved pure chorio-epitheliomas were present. This is a much lower incidence than was reported by Friedman and Moore, and Lewis. They reported a 12 per cent incidence of focal areas of chorio-epithelioma in embryonal carcinoma and teratocarcinoma (which have been included among the teratomas in this paper). From a study of their work it has

been concluded that they were including small focal areas which resembled chorio-epithelioma but which could have been due to necrosis and the resultant giant-cell formation. Broders is of the opinion that these are adenocarcinomas imitating a chorio-epithelioma.

TABLE 1
CLINICAL DATA IN SEVEN CASES OF CHORIO-EPITHELIOMA IN A MALIGNANT TERATOMA

	No. of Cases
Painful enlargement of the testis	5
Painless enlargement of the testis	2
History of trauma	1
Duration of the illness:	
One month to one year	4
Over one year	3
Side of the lesion:	
Right	6
Left	1
Metastasis:	
Pulmonary	2
Other than pulmonary	3
Hydrocele	1
Undescended testis	1
Gynecomastia	0
Positive Friedman	1
Excess of prolan	1
Hormone assay not done	5
Treatment:	
Orchectomy alone	0
Orchectomy and roentgen therapy	7
Survival:	
Less than one year	5*
One year	0
Two years	1
Five years	0

* In addition, one patient was last heard from eleven months after treatment but was reported as having "inflammation about the inguinal glands."

In our study only those areas that had unquestionable dark-staining, basophilic, large, irregular syncytial cells having large nuclei and sending out protoplasmic processes and having no growth pattern were considered as containing true chorio-epitheliomatous elements. Grossly these tumors followed the usual pattern, being either solid or cystic, and having areas of necrosis, pigmentation and hemorrhage. Microscopically, the only specimens that were considered to present positive evidence were those in which definite syncytial elements could be recognized. There were quite a few specimens in which there appeared to be Langhans cells with large round nuclei and lighter staining cytoplasm but it could not be proved that these were Langhans cells because such cells are not distinctive enough to be identified conclusively. In no sections could they be definitely identified as being associated with the syncytial elements although it must be postulated that they are present if there is to be an increase in the excretion of chorionic gonadotropic hormone. Since all of these chorio-epitheliomatous elements arose in monodermal teratomas, it could be that Langhans cells would be impossible to distinguish in many instances. In no instances were neural crests or other embryonic elements described by Melicow encountered.

Chorio-epitheliomas and tumors that contain chorio-epitheliomatous elements excrete a high amount of the chorionic gonadotropic hormone. In five of the seven cases of chorio-epithelioma in this study no hormone assay was done. The patient in one of the cases gave a positive result with the Friedman test and another had a very great excess of prolan. In one other case there was a level of 2,000,000 units of prolan but no chorio-epithelioma could be found in the testis. The tissue could have been "extragenital." Hormone assays should be done with adequate controls and a knowledge of what one is seeking. In any cases in which there is production of chorionic gonadotropic hormone, serial sections should be made in order to arrive at an accurate diagnosis. Gynecomastia was not a prevalent symptom, having occurred in only eight cases of teratoma of the testis in our series. This does not mean that it was not present since in some cases the data were incomplete and in others the possibility was not thought of or searched for.

Those teratomas that contain chorio-epitheliomatous elements usually have a rapid onset in more than half the cases but this is not conclusive. The teratomas that do contain chorio-epitheliomatous elements are more rapidly fatal than are those of the monodermal, bidermal and tridermal types

in which these elements are absent. None of the patients who had tumors with chorio-epitheliomatous elements lived more than two years, and five of the seven patients died within one year. One had no further follow-up.

CONCLUSIONS

1. Chorio-epitheliomatous elements do occur in malignant teratomas of the testis.

2. The presence of chorio-epitheliomatous elements in a teratoma indicates that it is a more primitive type; thus it is a more malignant type and it should excrete large amounts of the chorionic gonadotropic hormone.

3. The greatest incidence of teratoma is in the third decade but a large number of cases also occurs in the fourth decade. This also seems to be true of the teratomas which contain chorio-epitheliomatous elements.

4. If there is an appreciable output of the chorionic gonadotropic hormone, there should be secondary changes in other structures, namely, the development of gynecomastia, hyperplasia of the prostate and seminal vesicles, and pigmentation about the areola. These changes have not been noted or, if they have, they have not been recorded in the majority of cases. That this hormone is produced by the Langhans cells has been proved by others but no conclusion concerning this could be drawn from our study. The hormone assay should be done before operation, adequate controls should be used, and the type of hormone should be determined if the assay is to be of value in prognosis.

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EARLY CARE OF THE TRAUMATIZED HAND WITH PEDUNCULATED FLAPS

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NUMEROUS procedures have been advocated for the reconstruction of the traumatized hand. Of these the use of the contiguous and single pedicle direct flap has been found preeminently adaptable to the early repair of this extremity. An operation employing the pedunculated flap has shown excellent results. Rapid replacement of lost tissue, the successful return of function, sensation and strength, and the cosmetic appearance of the hand recommend the efficacy of this method.

In World War II wounds caused by high explosives, heat and cold, crushing and gunshot wounds required a cover replacement. The direct pedunculated flap gave the best and most rapid replacement for the protection of the functional structures. Except for special indications the following types of flaps were used: the single pedicle direct flap, the double pedicle direct flap, the glove type and the delayed. When available the contiguous flap is preferred because sensation is present immediately and in most instances the cover is complete in one operation. When not available recourse is made to remote areas, with the lower chest and abdomen furnishing adequate tissue. According to Koch[1] two main requisites for a successful flap are blood supply and comfort to the patient. The single pedicle direct flap may be applied with equal ease and assurance of a take to either the palm or the dorsum of the hand. The embarrassment coincident with the hand pulling out of a thigh pocket and the discomfort to a patient of using the back is avoided.

The goal in all reconstruction is function, sensation, strength and appearance. These four qualities are approached only in varying degrees dependent upon the injury and the repair. According to Koch[2] maximum functional results can be obtained only by early replacement of tissue lost; to accomplish this it is necessary to cover every compound wound with skin and subcutaneous tissue. This is especially true of hand wounds when tendons, nerves, muscles, blood vessels, bones and joints are exposed.

These wounds are contaminated but not always infected. As time is a factor in infection, an arbitrary six hours has been found to be the upper limit for primary repair. However, with meticulous surgery and antibiotics this time may be extended in some patients, but an adequate cover may be applied, regardless of the age of the wound.

An accurate diagnosis can usually be made by the application of a few simple tests and the x-ray. Sensation will usually give a clue about the nerves and function will act as a guide for severance of the tendons. The x-ray should show bone and joint disorders. This examination can be made without disturbing the original dressing.

OPERATIVE PROCEDURE

A general anesthetic is most desirable because usually two or more areas are involved. The operation on the hand should be bloodless. This is best accomplished by squeezing the blood out of the hand, forearm and arm with an Esmark bandage, applying a blood pressure cuff above and maintaining a pressure of approximately 300 mm. of mercury in adults and about 250 mm. in children. If infection is present,

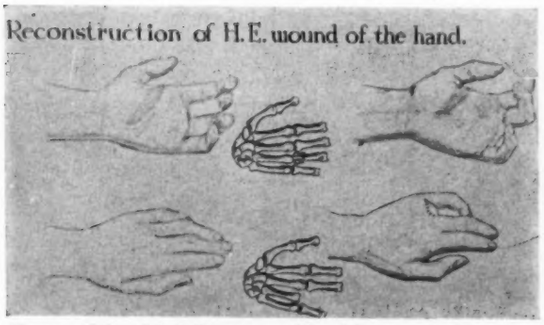


FIG. 1. The third finger sacrificed because of a compound comminuted fracture of the proximal joint of the digit; the function of the hand is jeopardized if third finger is left.

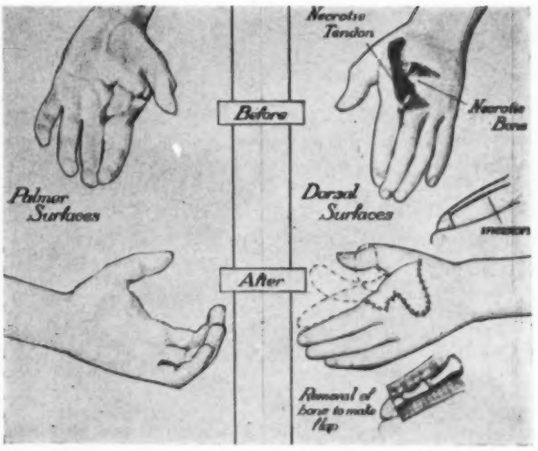


FIG. 2. The soft tissues of an irreparable digit utilized as a contiguous flap.

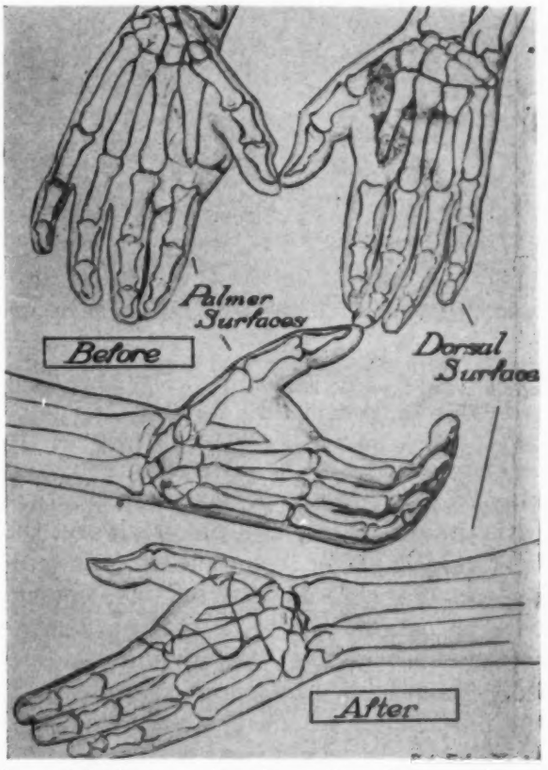
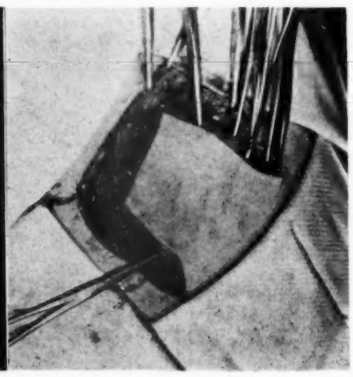


FIG. 3. The bone repair and cover by using a contiguous flap of an irreparable digit.

the Esmark is used with caution for fear of forcing infection deeper into the tissues.

When the patient is in the operating room, the original dressing is removed and the wound covered with sterile gauze. The surrounding area is shaved, cleansed with soap and water, dried with ether and then painted with 2 per cent iodine. Nothing is applied to the wound itself. The hand is draped and donor areas are prepared at this time. The operation begins by excising all traumatized skin from the skin margins of the wound. Débridement is accomplished by starting at one edge removing all devitalized tissue with sharp dissection, leaving only live, healthy structures. Tendons, nerves and articular surfaces are spared débridement but any gross contamination is removed from the surface. Bone ends are chiseled back to normal bone so only live, healthy tissue remains. This results in a clean, healthy wound. Tendons and nerves may often appear to be of questionable vitality. However, they should be conserved unless definitely devitalized as many times they will result in normal functioning structures.

The social and economic status of the patient enters the plan of repair because a laboring man will require a strong repair and the professional man wishes a repair which is not noticeable. Anatomy and physiology of the hand must be taken into account in the repair or the result will be displeasing. An example of this is a compound comminuted fracture of the first metacarpal joint of the third finger. A sacrifice of the digit will result in a better repair than an attempt at reconstruction because the hand will be partially frozen in either flexion or extension. This is true of other joints to a certain extent but not to the degree that this joint will affect the hand. (Fig. 1.)



4 5

FIG. 4. Traumatic wound requiring skin and subcutaneous cover.
FIG. 5. Flap outlined and incisions carried into the fat.

6 7

FIG. 6. The flap undermined and raised ready for the skin graft to the bed.
FIG. 7. The skin graft placed in the bed.

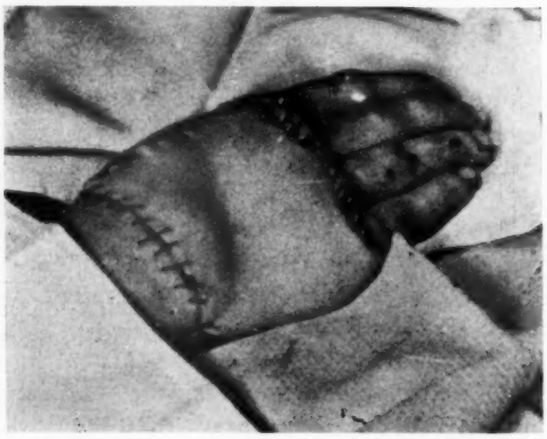


FIG. 8. The flap sutured to the skin of the hand.

The soft tissues of an irreparable digit may be used for a contiguous flap that will carry its own nerve and blood supply; the operation may be complete in one procedure. (Fig. 2.) Sutures of silk, cotton, wire or catgut will be found most satisfactory and the finest suture material possible should be used commensurate with the purpose for which it is employed. Silk has been most widely used in this group of patients because of its tissue tolerance, economy, availability and ease of handling. Bunnell[3] has found stainless steel wire to be of value for the reason that it may be removed with little, if any, untoward tissue reaction. Catgut is limited to ligatures and the finest possible are used.

For the remote flap the arterial supply of the lower chest and abdomen is utilized and the operation is planned, if possible, to include these vessels which are derived from the internal mammary above and the deep epigastric below. Scarred areas are avoided as they tend to embarrass the blood supply. Irradiated areas are never used if other tissues are available because of the low threshold of infection and the questionable blood supply.

The defect of the hand is outlined by placing a dry gauze sponge on the surface of the wound, the stain producing a pattern. If a permanent record is desired, it may be reproduced on a piece of lead or other metal. (Fig. 3.) The hand is now brought to the abdomen and a comfortable position found in which the vascular supply can be utilized. The pattern is then outlined on the chest or abdomen, the flap being made one-half to one-third larger than the pattern to care for shrinkage. The

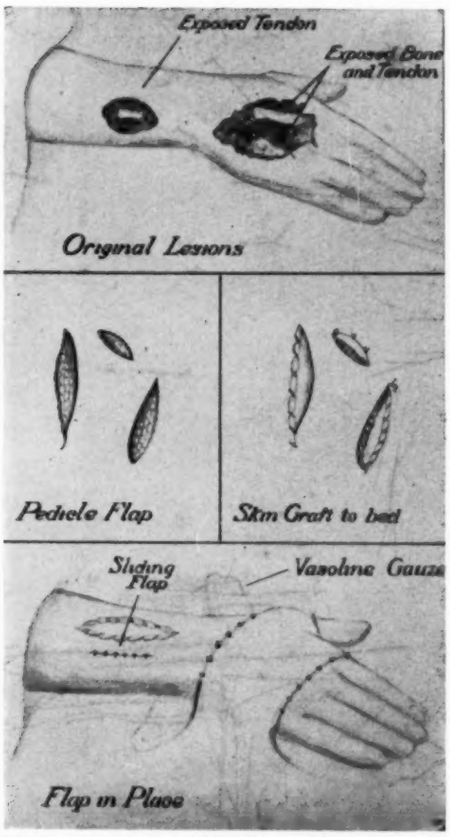


FIG. 9. Demonstrating the need of a combination or method for the repair of many hand wounds.

FIG. 10. The dressing applied to the flap.

pedicle is made approximately one-half as wide as the flap is long and fashioned so that it may be swung without tension or torsion. (Fig. 4.) Following the outline the incision is made into the fat for the desired depth, leaving a layer of fat in the donor area for a movable base for the skin graft. As the flap is undermined, the bleeding vessels are caught and ligated to the proximal end of the pedicle. (Fig. 5.) A thick split graft is then placed in the bed from where the flap has been removed and sutured into place. (Fig. 6.) The flap is now sewed to the hand, uniting the skin of the flap and the skin of the hand. Interrupted sutures are preferable because one stitch can be removed without interferring with the rest. (Figs. 7 and 8.) Three sides of the flap are sutured thus producing a wound which is nearly closed. If a double pedicle is used, two sides only can be closed and only the dorsum of the hand may be covered. (Fig. 9.)

The dressing is of primary importance in the operation. Plaster of paris is reserved only for special situations or a patient who will fight his dressings or position. The skin graft in the bed of the flap is first covered with two layers of fine mesh gauze, impregnated with petrolatum, then six to eight layers of dry gauze followed by mechanics waste for pressure. This dressing is fixed to the body with adhesive tape. The arm, forearm and hand are immobilized with a strip of adhesive tape 3 inches wide and attached to the scapula posteriorly going upward and forward over the shoulder, downward and laterally over the arm, medially to the olecran and forward and upward over the forearm and wrist to the body wall. Gauze is then placed between the limb and the body in such a fashion that the skin of the arm does not contact the skin of the body. Mechanics waste is placed between the bend of the elbow and the body to prevent motion. A modified

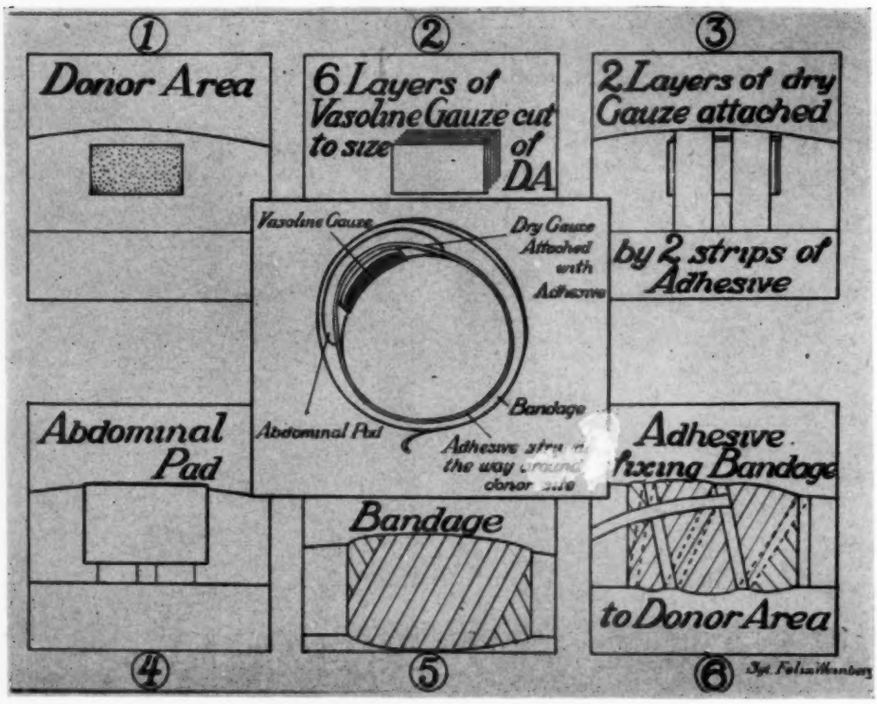


FIG. 11. The dressing of the skin graft donor area.

12 13

FIG. 12. Sectioning the flap.
FIG. 13. The proximal end of the pedicle fitted and replaced into its original bed.

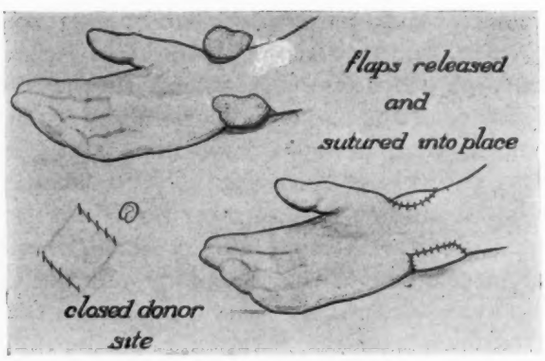


FIG. 14. The proximal ends of the flaps fitted and sutured into the defects as a finished procedure.

Velpeau bandage is applied and stabilized with a long strip of adhesive tape ½ inch wide. This bandage permits observation of the flap, continuation of indicated therapy and necessary toilet of the wound without disturbing the patient or the wound. The donor area is dressed with a firm dressing by using six layers of vaseline impregnated gauze covered with two layers of dry gauze cut to fit the donor area. (Fig. 10.) This is then fixed with adhesive all around the thigh. It is covered with an abdominal pad and fixed with a gauze bandage. This donor area will be healed in nine to fourteen days depending on the depth of the graft. (Fig. 11.) The patient is immunized against tetanus with 1,500 units of antitetanic serum intermuscularly which is repeated after each operation. If the individual has had toxoid, a booster dose is administered.

The flap is left attached for twenty-one days and then sectioned at the place on the pedicle that has been ascertained will fit the defect. Compression and partial sectioning of the pedicle is mentioned but the writer condemns this practice as several flaps have appeared injured by this procedure and nothing was gained. (Fig. 12.)

The proximal end after the pedicle is sectioned is replaced in its original bed and sutured into place. (Fig. 13.) The distal end is sutured to the skin of the hand after it has been undermined at the edge and the scar trimmed away to normal skin. (Fig. 14.)

The stitches are removed on the sixth or seventh postoperative day and indicated therapy continued such as splinting, physical therapy, etc. In most hands a combination of methods of repair will be used to advantage. This was first brought out by Koch.[2] He demonstrated the advantages of incorporating free grafts along with flaps in many instances or a combination of tissue transplants. (Fig. 9.) Bunnell[3] recommends the following sequence for repair: first cover second bone, third joint and finally nerves and tendons. The rationale of this sequence will be appreciated because bones require immobilization and tendons mobilization.

One hundred fifty-five pedunculated flaps are reviewed with the following tabulated results:

Delayed flaps	6
Direct flaps	144
Glove type	5
Wounds for which the flaps were used:	
Crushing	56
Burns	6
High explosives	48
Electrical wounds	2
Healed wounds	5
X-ray ulcerations	1
Others	5
Partial loss of flap	8
Loss of flap sufficient to require other tissue	3
Time lapse between injury and repair:	
Within 6 hours	10
Within 24 hours	17
Within 48 hours	15
Within 72 hours	2
Within 4 days	9
Within 5 days	9
Within 6 days	15
Seven days or more	46
Contaminated when seen	111
Definitely infected	3
Flaps and tendon repair at initial repair	5
Contiguous flaps	12
Combination of contiguous and remote flaps	18
Number of operative procedures	234
Flaps with skin grafts in combination	2
Number of full takes of skin grafts to the donor area of the flap	102
Number of skin graft failures to the donor bed	18
Wounds with foreign bodies	6
Number of double pedicle flaps	8
Average number of days for completion of the flap (direct pedunculated)	32
Average number of days to complete contiguous flap	14
Average number of days between application and severance of the pedicle of the flap	23
Number of flaps infected	1

SUMMARY

The literature related to tissue transplantation and the use of various types of flaps in surgical reconstruction of the hand is reviewed.

A series of 155 pedunculated flaps are presented as found in military and civilian practice and used on traumatized hands suffering loss of cover and exposed vulnerable structures.

The technic of an operative procedure which employs the contiguous and single

pedicle direct flaps is described. The importance of the dressing of the hand is emphasized in this operation.

The excellent results following the use of the pedunculated flaps are demonstrated by the successful return of function, sensation and strength, and the satisfactory appearance of the hand. They indicate the usefulness of the pendunculated flaps as a successful method of early repair of the traumatized hand.

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Often mixed tumors of the parotid gland recur after "removal" undoubtedly because they were incompletely removed. Surgeons are often hesitant to excise this gland completely because of possible or probable injury to the facial nerve traversing it. Besides, in some instances it may be that the tumor arises from multiple foci situated in different parts of the gland. Partial excision is apt to be followed by recurrence all the more so since the tumor has no true capsule and the myomatous character of it makes it hard for the surgeon to make sure his line of excision is wholly without the diseased tissue. A safer method, therefore, is to learn how to protect the facial nerve and yet totally extirpate the parotid gland. (*Richard A. Leonardo, M.D.*)

SURGICAL REVISION OF ARTHRITIC FEET*

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MANY patients recover from chronic arthritis of either the rheumatoid or degenerative type or reach a stage in which the disease is relatively quiescent and remain severely handicapped by residual deformities of the feet. These deformities involve especially the metatarsophalangeal joints and the toes. Not only may they render it difficult for the patient to wear ordinary shoes but these deformed arthritic feet may be painful with weight-bearing even when they are not forced into a shoe which is made to fit a normal foot.

Much has been written about surgery of the larger joints and even of the hands and fingers in chronic arthritis but I know of no paper on the surgical revision of the arthritic foot. On the other hand, I find it is possible to benefit a greater number of patients to a greater degree by a few relatively simple operations on the feet than by any of the elaborate procedures on the larger joints which occupy so much of the time and thought of the modern orthopedic surgeon.

No originality is claimed for any of the procedures mentioned in this article. They are operations familiar to most orthopedic surgeons. The fact that these may be combined in various ways to render arthritic feet more normal in shape, more flexible and less painful from the pressure of shoes or from weight-bearing is all too frequently overlooked both by the physician or rheumatologist and by the orthopedic surgeon. This article is written to call attention to that fact.

In considering the surgical treatment of an arthritic foot one should examine the foot with the purpose of ascertaining all of the causes of pain and disability in the foot in order that the surgical procedures may be so planned that the foot will be rendered as useful and as free from pain as possible by one operation. Sometimes this will involve ten or more different procedures on the two feet. It should also be determined that there is sufficient function in the knees and hips of the patient to enable him to walk enough to derive some benefit from the operations on the feet after they have been performed successfully and the operative wounds have healed. One is rarely justified in performing the plastic procedures recommended in this article on a patient who is going to be confined to a wheelchair regardless of the condition of his feet. On the other hand, if the patient can walk even a little, it may be that relief of the painful conditions of the feet will be greatly appreciated and will extend considerably the range of his activities.

Whether the foot is crippled by degenerative or rheumatoid arthritis, the disabling and painful conditions which are amenable to surgical treatment involve especially the forefoot and toes. Those which we see most frequently are the following, namely, bunions with or without hallux valgus, hammer toes with painful corns, painful calluses on the balls of the feet due to depression of one or more metatarsal heads, overriding toes or flexion deformities of the toes with painful calluses on the ends of the toes, rigidity of the metatarso-phalangeal joint of the great toe with or without bunions and other exostoses on the head of the metatarsal. Two or more of the aforementioned conditions may be present in each foot and while the disability is often bilateral, the deformities in the two feet of the patient often differ considerably and each foot demands individual consideration and treatment. Not only must each deformity or

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cause of disability be corrected but allowance must be made for the development of new pressure areas after the correction of existing deformities. For instance, the correction of a hammer toe deformity may cause a mild deformity of an adjacent toe to be subjected to undue pressure and so it is advisable to correct this toe also.

The hallux valgus with the bunion is corrected by excising the bunions and the base and about half of the shaft of the first phalanx of the great toe (modified Keller operation). Usually, no attempt is made to cover the cut end of the shaft of the phalanx with soft tissue. (Figs. 1 and 2.) Occasionally, one or both sesamoids are removed; and if the forefoot is unusually broad, the first metatarsal is cut across near its base and the head of the metatarsal is forced toward the midline of the foot and the gap at the osteotomy site is wedged apart with the bone removed from the bunion. This procedure narrows the forefoot to a considerable degree and does not greatly prolong convalescence.

The same operation is used for hallux rigidus except that usually it is not necessary to excise a bunion. However, in this condition one or more smaller exostoses may be present on the dorsal and lateral surfaces of the metatarsal head and these are chiseled off until a relatively smooth and narrow metatarsal head is left. (Figs. 3 and 4.)

The hammer toe deformity most frequently involves the second toe and consists of hyperextension of the first phalanx on the metatarsal head and flexion at the proximal interphalangeal joint. The prominent dorsal surface of this joint is often surmounted by a painful corn. The toe is first manipulated in flexion and the dorsal portion of the metatarso-phalangeal joint capsule is incised with a tenotome if this is necessary to correct the hyperextension of the first phalanx. Then the deformity can be corrected satisfactorily by excising the corn transversely and extending the incision down to include the extensor tendon and joint capsule. The prominent head and about half or more of the shaft of the first phalanx are excised. As the wound is sutured, the closure of the defect caused by excision of the corn tends to correct the flexion deformity. This operation is also used to shorten the toe when the second toe is found to be unduly long after the deformity of the first toe has been corrected. This abnormal length or relative length of the second toe may be quite troublesome and cause difficulty in fitting shoes. The terminal and half of the middle phalanx of the toe may be amputated if desired but the shortening of the first phalanx accomplishes the same purpose and the cosmetic result is better.

In arthritis with clawing of the toes the base of the first phalanx often becomes fixed on the dorsum of the metatarsal heads and forces this downward causing a painful callus in the ball of the foot. The usual hammer toe operation will benefit this but is not sufficient to give complete relief as the base of the phalanx remains on the dorsum of the metatarsal head. Either the base of the phalanx including part of the shaft or the metatarsal head is excised. Sometimes both are excised. When one or two metatarsal heads are prominent in the sole of the foot, the excision can be done through a short vertical dorsal incision; but when all four lateral metatarsal heads are prominent in the ball of the foot, the excision is more easily done through a transverse plantar incision in the skin just distal to the metatarsal heads (Hoffman operation). In correcting overriding fifth toes the entire first phalanx may be excised and a suitable skin-plasty performed.

If the flexion deformity of the toe causes a painful callus on the end of the toe, this is corrected by the excision of a relatively wide dorsal wedge from the distal interphalangeal joint. This wedge includes skin, extensor tendon and bone; if desired, the entire middle phalanx may be removed if this is necessary to correct the deformity. The callus is not disturbed as it will disappear after the toe is straightened and the end of the toe is no longer subjected to ab-

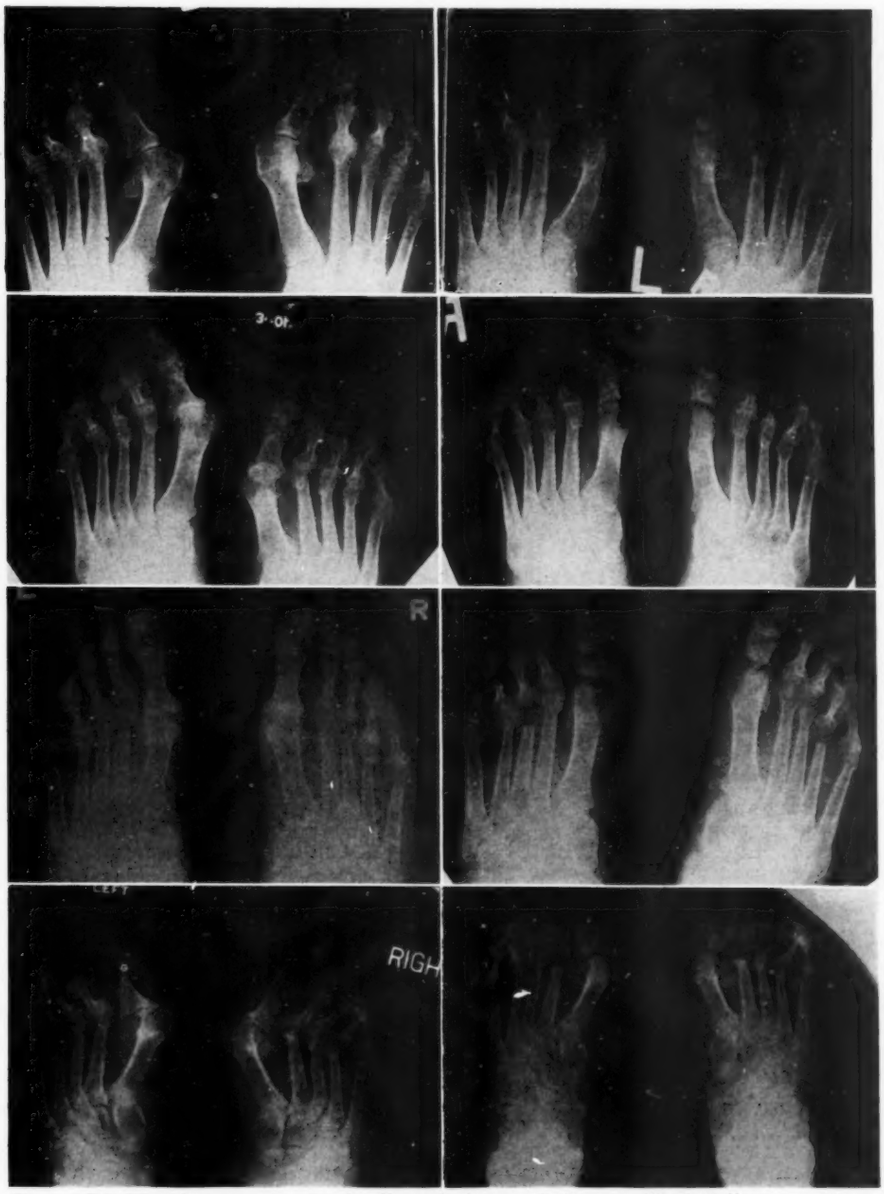

FIG. 1. Bunions, hammer toes and calluses before and after modified Keller operations; the base of the first phalanx of the second toe was removed on the left and the head of the corresponding bone was removed on the right.

FIG. 2. Bunions, hammer toes and calluses before and after operation; modified Keller operation and resection of head of first phalanx of first and second toes on each foot. Arthritic bursae were removed from the extensor tendon sheaths on each foot.

FIG. 3. Rigid painful feet with small bunions and large calluses before and after operation; modified Keller operation and multiple hammer toe operations on each foot. The head of the third metatarsal was resected on the left and that of the fourth was resected on the right. In addition to these calcaneal spurs were removed from each foot on account of painful heels.

FIG. 4. Severely deformed arthritic feet before and after operation; bilateral Keller operation and multiple hammer toe operations on each foot. The head of the second metatarsal was removed on the right and the second and third on the left. Three exostoses were removed from the forefeet and one from each heel.

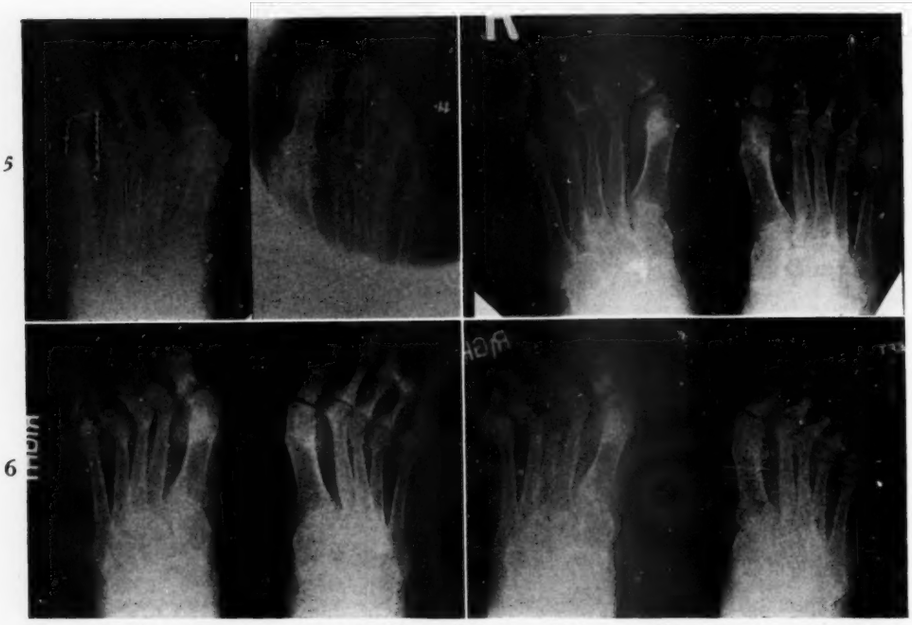

FIG. 5. Bunions, hammer toes and calluses before and after modified Keller and multiple hammer toe operations.

FIG. 6. The same feet years later and after a second operation in which the head of the third metarsal was removed on the right and three hammer toe operations were done on the left; the old operation on the fifth toe on the right was revised. This patient's chief complaint was the relatively long second toe on the left. This was corrected by the hammer toe operation on this toe.

normal pressure. The same is true of the calluses on the balls of the feet as these disappear after the removal of the metatarsal heads which cause them.

It is to be noted that in the aforementioned procedures the surgeon is not attempting to restore the foot to normal condition. He is merely attempting to so change its contour that an ordinary shoe which is properly fitted can be worn without causing undue pressure at one or several points, to restore movement to joints where this is desirable and to correct deformities or remove bones which are subjected to undue pressure with weight-bearing and cause painful calluses in the skin. The surgery tends to be destructive or at least ablative and should be moderately radical. Deformities are corrected by extensive removal of bone and movement is restored to joints by wide excision rather than by meticulous arthroplasties. In many instances, the activity of these patients will be restricted by age or by disease in other joints and they do not need feet which will stand hard daily usage but merely feet which will permit them to wear shoes and walk a little each day without pain. However, it is surprising to see how well some of them walk after the modified Keller operation for bunions on the great toes, the correction of hammer toes and the removal of the heads of one or two or even of all four lateral metatarsals of both feet.

Occasionally, exostoses in other locations namely, head of the fifth metatarsal, base of the first or of the fifth metatarsal or tuberosity of the os calcis, cause protrusions which are sufficiently troublesome to warrant removal of the underlying bone. Likewise, in rheumatoid arthritis subcutaneous nodules may form on the sides or dorsum of the feet or even on the heel. I have also seen cysts on the dorsum of the feet around the extensor tendons of the toes. These nodules and cysts should be excised if they interfere with the function of the foot. At operation corns are relieved by excision of

the underlying bony prominence which has caused the corn. Also, any markedly hypertrophied or thickened toenails are removed.

In most instances, these operations on the forefoot and toes are performed under local anesthesia; but when several operations on each foot are to be performed, general anesthesia may be advisable. When this is used, the operations may be performed under a tourniquet as this shortens the operating time and makes surgery less difficult. The general anesthesia also tends to make the surgeon a little more radical in the removal of offending bone and in the extending of the surgery to relieve all of the causes of disability in the feet. It is my experience that the surgeon is apt to err on the side of conservatism and occasionally it is advisable to operate on the feet a second time in order to correct conditions which were overlooked at the first operation or which have developed since that time. (Figs. 5, 6 and 7.) These arthritic patients stand surgery well and their tissues heal normally. I have seen no instance in which an exacerbation of the arthritis could be attributed to the operations on the feet.

The so-called calcaneal spurs, that is, the formation of a ridge of bone across the tuberosity of the os calcis at the attachment of the plantar fascia may be a prominent roentgenographic finding in patients with or without painful heels. The removal of this ridge of bone does not always relieve the pain and surgery on these painful heels is, as a rule, to be avoided. Occasionally in a case which has not yielded to prolonged conservative treatment surgery is reluctantly resorted to and may give relief.

Deformities of the posterior part of the foot are rare but a varus deformity in the mid-tarsal region or an equinus deformity at the ankle is sometimes seen. These are corrected by suitable wedge osteotomies through the mid-tarsal region or the ankle. After such an operation the foot is immobilized in a plaster cast in the corrected position and the atrophic bone unites promptly. The cast is left on for about eight weeks

FIG. 7. Bilateral Keller operations with hammer toe operation on the fourth toe on the left; the second toe should have been shortened on each foot.

and then the foot is protected from swelling by an elastic bandage and weight-bearing is begun gradually. If the ankle joint is intact, the equinus deformity may be corrected by lengthening the heel cord.

In all of the other operations mentioned it is advisable to keep the patient in the hospital for about two weeks. This is done because the patients sit up most of the day or walk on their heels if they are permitted to go home. As a result the feet become swollen, cyanotic and painful; convalescence is apt to be prolonged and the edges of the wound may separate. In these plastic procedures on the feet we use absorbable sutures, namely, No. 000 chromic and plain catgut for the deeper structures and No. 00 plain catgut for the skin. Non-absorbable sutures in the small wounds which are subjected to pressure or movement or both may cause trouble some weeks after the wound has healed and the use of the plain catgut in the skin saves the patient from the ordeal of having the sutures removed from the multiple small wounds. After operation the toes are held in the desired position by small gauze pads or dressings and a firm bandage is applied to the forefoot. This is changed on the second postoperative day and the patient is allowed up in a chair or he may walk a little if this is not too painful. However, he is kept in bed with his feet elevated if necessary for enough of the day to control the swelling. The less the swelling, the shorter the convalescence. At the

end of two weeks all dressings are removed except a snug gauze bandage around the forefoot and toes and he is encouraged to put on shoes and walk a little. Within four weeks after the operation he is usually walking quite well and is fairly comfortable but he may be expected to continue to improve slowly over a period of several weeks. If the surgeon wishes, the toes and the feet may be immobilized in a plaster of paris cast after the operation. When used, these are left on for about two weeks.

CONCLUSION

Many patients with deformed and painful arthritic feet can be greatly benefited by multiple relatively minor surgical procedures.

In younger adults organic stricture of the esophagus is often due to chemical or mechanical trauma whereas in older individuals cancer of the esophagus is the most common etiologic factor of such a stricture. When esophagoscopy and biopsy prove that the lesion is benign, one is justified in attempting to stretch the stricture gradually by the passage of progressively larger bougies; fully 60 per cent are benefited by such conservative therapy. However, should surgery later become indicated, excellent results are obtainable by esophageal resection of the stenosed area followed by end-to-end anastomosis. (*Richard A. Leonardo, M.D.*)

INTUSSUSCEPTION IN THE ADULT*

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INTUSSUSCEPTION is so commonly found in the infant and small child that its occurrence in the adult is rarely considered when dealing with patients with acute abdominal complaints. Too few cases appear in any surgeon's practice or even in any one hospital to enable an over-all picture of the condition to be formed. At the Albany Hospital in the twenty-one years from 1927 through 1947, of 242,829 patients there were thirty-three cases of intussusception, twenty-one in children and twelve in patients fifteen years of age or older.

Because of the rarity of the condition the authors have reviewed the literature on all cases of intussusception in the adult from 1900 through 1947 reported by American and English writers. The foreign literature has not been reviewed because of the paucity of information in many of the cases reported and the unavailability of many of the journals. Since 1901 numerous authors have contributed to the literature on this subject.[1–16]

Age and Sex. From a review in the literature (American and English) of the 665 cases 225 occurred between the ages of fifteen to thirty, 201 between thirty-one to forty-five years, 147 between forty-six to sixty, sixty-five between sixty-one to eighty years and two between eighty-one to ninety. In adults there were sixteen occurrences; there were no data in nine. There were 401 cases in males and 225 in females; there were no data in nine cases.

It is interesting to note that in the 158 cases of so called primary intussusception ileo-ileal, ileocecal and ileocolic form 68 per cent; colocolic, appendicocecal and cecocolic occupy 19 per cent and other types 13 per cent.

It is the authors' opinion that there should be a classification which depends on the parts of the gastrointestinal tract involved. The common terms now applied are ileocecal, ileocolic, enteric and colic. We believe that these terms are too inclusive and that from the standpoint of true description a more explicit classification should be made. We propose the following classification: gastroduodenal, jejunogastric, duodenoduodenal, duodenojejunal, jejunojejunal, ileojejunal, ileo-ileal, ileocecal, ileocecocolic, appendico-appendiceal, appendicocecal, cecocolic, colocolic, sigmoido-sigmoidal, sigmoidorectal and colorectal, and ileocolic.

CASE REPORTS

Case I. An eighty-nine year old white male, No. A45707, was admitted with the chief complaint of almost continuous vomiting for two days. The bowels and bladder were uncontrollable. There were epigastric pain and anorexia over long period of time but no melena. The abdomen was negative on palpation. Intestinal clicks were present. The patient expired within two hours after admission. At autopsy jejunojejunal intussusception was revealed but no etiologic factor for that condition was found.

Case II. A fifty-one year old white male, No. 1592-27, was admitted with the chief complaint of pain in the upper abdomen radiating to the back and left shoulder. Thirty-five years before he had had stomach trouble. For the two weeks before admission he had vomited occasionally and was nauseated a good share of the time. No hematemesis or melena was present. Examination of abdomen showed extreme relaxity, asymmetry, patterns and distention. There was an area of resistance in the

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right lower quadrant. There were no masses and a rectal examination was negative. The operative diagnosis was ileocecal intussusception due to carcinoma of cecum.

CASE III. A forty-five year old male, No. 253329, after a drinking bout was awakened suddenly with severe pain in the umbilical region; there was progression of pain accompanied with excessive vomiting. Previous bowel movements had been normal. There was slight distention with tympany above the umbilicus. Tenderness and rigidity were present in the right lower and upper quadrants extending to the left upper quadrant. The operative diagnosis was ileo-ileal intussusception but no etiologic factor for that condition was found.

CASE IV. A twenty-five year old male, No. 61365, complained of diffuse abdominal pain which had increased in intensity. He was in moderate shock. No history was obtainable. The operative diagnosis was ileo-cecal intussusception but no etiologic factor for that condition was found.

CASE V. A sixty-four year old woman, No. A4124, complained of periumbilical pain, distention, nausea and vomiting. For about one year she had had occasional bouts of colicky abdominal pain associated with distention. The day before admission she was awakened with periumbilical pain, some distention and belching of a great deal of gas followed by nausea and vomiting. Two days previously she had had a normal bowel movement. Enemas produced a fair amount of feces but not gas. Her abdomen was greatly distended, principally in both upper quadrants. There was rigidity but no mounds or masses were present. There was shifting dullness in both flanks and clicks were present. The use of the Miller-Abbott tube was successful and the patient was discharged nine days after admission without operation. Three months following discharge the patient had abdominal cramps followed by distention, nausea and vomiting. There was no melena. The abdomen was symmetrically distended; there was no tenderness, rigidity or masses. Shock developed and the patient suddenly died. At autopsy ileo-ileal intussusception due to lipoma of ileum was found.

CASE VI. A fifty year old woman, No. 64079, entered the hospital because of prolapse of rectum. She was well until one week prior to admission when after straining at stool she noticed a mass protruding from the anus. There was no pain or rectal bleeding but there was slight constipation. Examination revealed a firm, rounded, non-tender mass the size of small orange in the right lower quadrant. There were small uterine fibromas. Rectal examination revealed a protrusion of the mucosa. The operative diagnosis was sigmoidorectal intussusception, carcinoma of the sigmoid and uterine leiomyomas.

TABLE I

ETIOLOGIC FACTORS (OTHER THAN TUMORS) IN THIS SERIES

Meckel's diverticulum	43
Prior gastroenterostomy	27
Prolapse of gastric mucosa	18
Hypertrophy of gastric mucosa	8
Typhoid ulcer	8
Bands, adhesions	5
Colostomy	5
Tuberculous ulcer	5
Aberrant pancreas	2
Fasting	2
Foreign body	2
Gunshot or stab wound	2
Invagination of appendix	2
Megacolon	1
Redundant colon	1
Traumatic	1
Chronic gastritis	1
Chronic ulcerative colitis	1
Dysenteric ulcer	1
Enlarged glads	1
Fetal appendix	1
Healed gastric ulcer	1
Hernia, femoral	1
Mobile cecum	1
Rectal prolapse	1
Visceral purpura	1

CASE VII. A sixty-three year old male, No. 80788, complained of abdominal distention and vomiting of six days' duration. The present illness began approximately two months prior to admission when the patient frequently noticed a sour stomach. He had had no bowel movement for five days. There was no melena, pain, tenderness, rigidity or mass. The abdomen was symmetrically distended. Rectal examination was negative. The operative diagnosis was ileo-ileal intussusception but no etiologic factor for that condition was found.

CASE VIII. A fifty-nine year old man, No. A7669, was admitted with a history of poor appetite, constipation, nausea, borborygmus and loss of weight for the past six weeks. Symptoms had increased in the last two weeks before admission. The abdomen was symmetrically distended. There were no patterns. Slight tenderness was present throughout the

abdomen, principally in the upper quadrant. There was no mass but active clicks were present. The operative diagnosis was ileo-ileal intussusception due to leiomyosarcoma of ileum.

with cathartics. There were no other gastrointestinal symptoms. Marked rigidity in the right lower abdominal quadrant was present as was tenderness just below McBurney's point. A firm, tender mass was palpated in this region.

TABLE II
BENIGN TUMORS CAUSING INTUSSUSCEPTION

	Lipoma	Fibroma	Leiomyoma Myoma	Myoma	Papilloma, Adenoma, Polyps	Cyst	Hemangioma	Carcinoid	Enterocystoma	Villous Growth	Soft Tumor	Lymphoid Cell Tumor	Argentaffinoma	Polypoid Tissue	Tumor	Total
Stomach	1	..	1	..	6	..	..	..	..	..	..	..	..	..	..	8
Duodenum	..	..	..	..	5	..	..	..	..	1	..	..	..	..	..	6
Jejunum	3	2	2	..	22	..	1	1	..	..	..	..	..	..	1	32
Ileum	27	19	6	2	51	..	1	..	1	..	..	1	1	1	1	111
Appendix	..	..	..	..	..	8	..	1	..	..	..	..	..	..	..	9
Cecum	13	2	..	..	4	..	..	..	..	..	1	..	..	..	..	20
Colon	16	2	..	..	3	..	..	..	..	..	..	..	..	..	..	21
Rectum																
Sigmoid	3	..	..	..	3	..	..	..	..	..	..	..	..	..	..	6
																213

Benign tumors 63%
Malignant tumors 37%

CASE IX. A fifteen year old boy, No. 46286, had an attack of epigastric pain about six weeks before admission followed the next day by the passage of semi-digested blood by rectum. One month later another such episode occurred without the passage of blood. Two days before admission a similar attack occurred but with severe low back ache, generalized abdominal pain, nausea and vomiting. Constant crampy pain in both lower abdominal quadrants replaced the backache. The patient had no bowel movement for two days. The boy was acutely ill. Diffuse abdominal pain was pronounced. There was tenderness in both lower quadrants but no mass was palpable. Rectal examination revealed moderate tenderness on both sides and a questionable mass. The operative diagnosis was ileo-ileal intussusception and acutely inflamed Meckel's diverticulum.

CASE X. A twenty year old student, No. 663831, complained of dull pain in the epigastrium for thirty-six hours and one attack of vomiting followed by sharp lower abdominal pain lasting for one week. The patient was constipated but good results were obtained Temperature and pulse were normal. At operation appendicocecal intussusception was found.

CASE XI. A fifty year old man, No. 74068, complained of abdominal cramps and constipation for two years. Twenty years before he began having attacks of lower abdominal pain especially severe in the left lower quadrant, this having become more severe in the five weeks before admission. The attacks consisted of crampy pains lasting for a few minutes to as long as six hours. Constipation was relieved by laxatives. There was no melena. The abdomen appeared flat and symmetrical. No patterns, rigidity, masses or mounds were seen or felt. At operation jejunojejunal intussusception and polyp of jejunum were found.

CASE XII. A thirty-four year old woman, No. 17795, complained of anorexia and loss of weight in the five weeks before admission. Three weeks before admission she had had nausea, vomiting and generalized abdominal pain and melena. The following day the pain was less severe but was cramp-like. Nausea and vomiting continued; constipation was severe. Three months previously the patient

had been delivered of her third child. The abdomen was distended tympanitic and there were audible peristalsis and moderate abdominal tenderness. At operation appendicocolic intussusception and carcinoid of appendix were found.

3. The most common etiologic factors of intussusception in the adult are tumors, Meckel's diverticulum, prior gastro-enterostomy and prolapse of gastric mucosa. Other causes as enumerated in Table 1 have been given.

TABLE III
MALIGNANT TUMORS CAUSING INTUSSUSCEPTION
Total Number, 123

Total		Carcinoma	Carcinoid	Sarcoma	Melanoma	Lympho-blastoma	Malignant Polyp
2	Stomach	2					
10	Jejunum	6	1	3			
40	Ileum	9	1	21	3	4	2
29	Cecum	25	1	3			
2	Appendix	1	1				
30	Colon	27	..	1	..	..	2
10	Sigmoid and rectum	10					

SUMMARY

1. Intussusception in the adult although a rare condition is more commonly found than heretofore supposed.

TABLE IV
TYPES OF INTUSSUSCEPTION IN SERIES OF 665 CASES

Gastroduodenal	36
Gastroduodenojejunal	1
Pyloropyloric	1
Gastropyloric	1
Jejunogastric	29
Duodenoduodenal	4
Duodenojejunal	3
Jejunojejunal	53
Jejuno-ileal	4
Ileojejunal	1
Appendico-appendiceal	8
Appendicocecal	20
Appendicocecocolic	4
Appendico-ileo-colic	3
Ileo-appendico-cecal	2
Ileo-appendico-colic	1
Ileocecocolic	1
Ileocecal	95
Ileo-ileal	205
Ileocolic	82
Colocolic	55
Cecocoli	25
Cecal	1
Small intestine	2
Sigmoidosigmoidal	11
Sigmoidorectal	14
Colorectal	5
Epiploicosigmoidal	1

2. In analyzing a large series of cases it is convenient to revise the old classification of intussusception.

4. The age factor should be considered important in the forming of a diagnosis but bear in mind, as Table 1 shows, any age may be affected. Patients between the ages of fifteen and twenty-five show a predominance.

5. Males are more often affected than are females.

6. Benign tumors were the etiologic factor in 213 cases while malignant tumors occurred in 123 instances. (Tables II and III.)

7. The so-called primary cases show a large number in this series although it is believed that had meticulous care been taken in the discovering of some etiologic factor, many would have been included in the secondary listing. However, many cases following careful examination are primary.

8. The great percentage of primary intussusceptions in the adult are of the ileo-ileal, ileocecal and ileocolic type. (Table IV.)

9. The symptomatology in cases of intussusception in the adult is so undefinable that a definite diagnosis can be made only rarely.

10. In analyzing this series of cases (665) nausea, vomiting, irregular attacks

of colicky pain, recurrence of attacks and constipation are present with few exceptions. Abdominal masses were found in about one-half of the cases while abdominal tenderness, rigidity and melena were most infrequent. As complete obstruction develops, the patients present the usual signs and symptoms of obstruction including distention, patterns and an absence of abdominal clicks replacing the lively clicks heard before complete obstruction developed.

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CAUSES AND METHODS OF REPAIR OF DIRECT AND RECURRING INGUINAL HERNIAS

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THE history of repair of inguinal hernia dates back to very early records. The famous Roman, Celsus, who lived in the first century, operated upon inguinal hernias. Attention is called to this historic fact merely to point out that over such a span of time a great number of opinions and ideas have developed regarding the etiology and treatment of inguinal hernia. It is understandable that many of the operations described have points in common. It seems incredible that further original ideas could be advanced. The fact that recurrences are relatively common even today suggests that surgeons must be spurred on to further efforts to overcome seemingly insurmountable obstacles. It is encouraging to note that with the acquisition of more information, greater skill and improved technics few hernias are considered inoperable today.

Until fairly recently all repairs of inguinal hernia have had two points in common, namely, (1) high ligation and extirpation of the sac and (2) utilizing the shelving margins of the inguinal (Poupart's) ligament as the anchor site for various structures brought down from above and fastened to it. There is a growing opinion that full dependence upon the use of Poupart's ligament is a mistake; that it is frequently inefficient and even injurious; that it is physiologically and anatomically an incorrect procedure. The senior author (J. K. H.) was interested in seeing and operating upon a large number of recurrent inguinal hernias among soldiers while in recent military service. Most of these patients had been subjected to multiple operations, some three or four times. In a large percentage of these cases Poupart's ligament was torn out, disintegrated or partly destroyed. In some cases the inguinal ligament was displaced superiorly so that the lower inguinal region was exposed beneath it. It seemed obvious that the success of any further surgery depended upon utilizing some structures other than Poupart's ligament as an anchor for attachment of tissue structures brought down to cover Hesselbach's triangle.

Ordinarily about 10 per cent of inguinal hernias are direct. As high as 50 per cent of recurrent inguinal hernias are direct. This suggests that probably a large percentage of patients operated upon for indirect inguinal hernias have been subjected to a procedure which encouraged development of direct hernia, or that a direct hernia was overlooked at the time of surgery. Inasmuch as there is ordinarily no developmental defect involving any structure except the processus vaginalis (sac) in indirect hernias, a high percentage of cures may be effected solely by high ligation and extirpation of the sac. In infants and young children it is probably preferable to do only this. As indirect hernias are frequently complicated by developmental weakness in the inguinal canal or Hesselbach's triangle, it is considered important routinely to reinforce this region. The classical hernia operations for accomplishing this are well known and commonly used. However, with a clearer understanding of the more recent anatomic observations they should inevitably become obsolete.

The crux of the situation in direct hernias lies in the weakness of the floor of Hesselbach's triangle in the area between the interfoveolar ligament and the lateral margin of the so-called conjoined tendon. This weakness is due to the failure or absence of

muscular fibers of the internal oblique and transversalis muscles which normally cover Hesselbach's triangle. Ordinarily the internal oblique covers the entire inguinal region. Anson and McVay have shown that in 3 per cent of patients the inferior extent of the internal oblique muscle is mid-way between the anterosuperior iliac spine and the pubic spine. The inferior extent of the transversalis muscle is as far as the spermatic cord in only 3 per cent. In only 7 per cent does it form an arching border as conventionally described. In 43 per cent the muscle fibers terminate between the anterosuperior spine and the mid-point on the inguinal ligament; in 26 per cent they do not extend inferior to the anterosuperior spine. In about half the cases the muscular portion covers only the lateral two-thirds of the trapezoidal area between the inguinal ligament and the lateral border of the rectus sheath.[1] It is in this area of muscle failure or defect, bounded above by the lower margin of the internal oblique, the rectus margin medially and the inguinal ligament laterally, that the unsupported transversalis fascia gives way and direct hernia presents.

It is important at this point to clarify the term transversalis fascia. As described in Gray's Anatomy, it is a thin, aponeurotic membrane which lies between the inner surface of the transversalis and the extraperitoneal fat. "It forms part of the general layer of fascia lining the abdominal parietes and is directly continuous with the iliac and pelvic fascia."[2] According to Anson and McVay it is a continuation downward from the free lower muscular border of the transversalis of an aponeurotic membrane which completes the musculofascial sheet of this layer. This aponeurosis, usually designated the transversalis fascia, is the layer which comprises the floor of the inguinal canal.[3] This apparent discrepancy must be duly appreciated in order to evaluate properly the principles of repair outlined by various writers on the subject.

The method of repairing direct hernias and certain indirect hernias which the senior author has used with uniform success for the past several years differs from other methods in a few respects. It would seem impossible for anyone to present any entirely original method. It combines several ideas, some previously described, and ignores Poupart's ligament. Its theory is based upon growing conviction, "that the underlying predisposing anatomical basis for direct hernia consists of a congenital absence of adequate muscular support for the lower portion of the inguinal canal."[3] The so-called sac is either removed or imbricated. The defect in the transversalis fascia is repaired as well as possible. The superior surface of the ascending ramus of the pubis is explored and Cooper's ligament is visualized. It is carefully freed of all preperitoneal fascia and connective tissue. This ligament is the condensed strip of connective tissue which consists of the fascia of pectineus muscle where it arises from the pubic pecten, which is the anterior half of the pectineal line. This fascial origin is further strengthened by fibers from Gimbernat's ligament that extends along the pubic pecten and intermingles with the

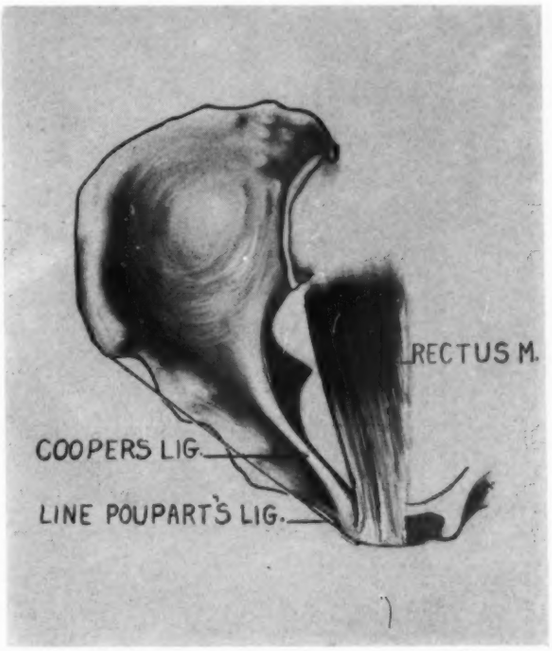

FIG. 1. Relation of rectus tendon to Cooper's ligament. (HOLLOWAY and JACKSON. *West. J. Surg.*, 56: 473–477, 1948.)

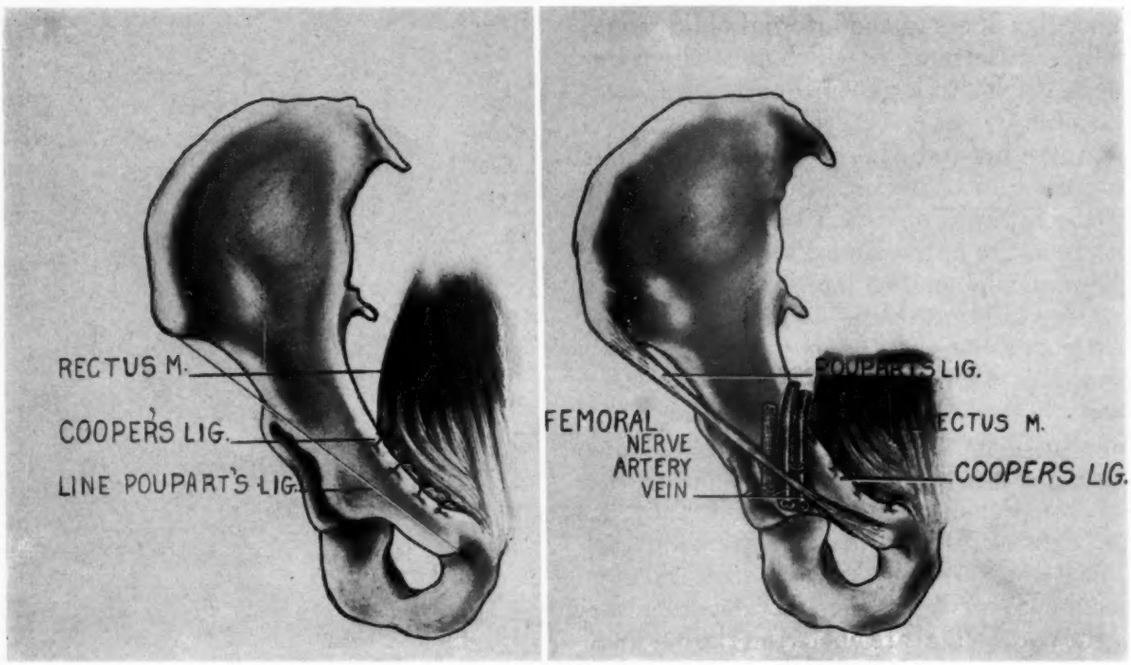

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FIG. 2. Application of rectus tendon to Cooper's ligament.
FIG. 3. Same as Figure 2, with femoral vessels and nerve illustrated. (HOLLOWAY and JACKSON. *West. J. Surg.*, 56: 473–477, 1948.)

pectineal fascia, making a firm band of fascia attached to the pubic pecten. The inguinal aponeurotic falx, or conjoined tendon, is then opened from the superior margin of the pubis upward for about 3 inches, the point of entrance being along the posterolateral margin of the rectus muscle. Through this opening the lower lateral portion of the rectus muscle is seen originating by a tendinous structure that extends upward for a variable distance. (Fig. 1.) This tendinous portion is approximated and fastened by silk sutures to Cooper's ligament and the underlying periosteum as far laterally as the femoral vein or an abnormal obturator artery when present. (Figs. 2 and 3.) If the femoral or abnormal obturator vessels are carefully retracted, there is little danger of injuring them. The use of small, heavy, half circle needles facilitates this part of the operation where the operative space is relatively deep and small. Advantage is to be taken of complete relaxation at the time of this procedure. The rectus abdominis is a most elastic muscle. By attaching its tendinous origin along Cooper's ligament it easily stretches and fans out to form a relatively thick muscular floor for the medial significant part of Hesselbach's triangle, a floor which conforms to the contour of the inner abdominal wall.

The inguinal falx (conjoined tendon) is then approximated to Cooper's ligament anterior to the expanded portion of the rectus muscle from the pubic spine to the femoral vein. (Fig. 4.) In some cases in which the falx is deficient or is displaced too high above the pubic spine the lateral margin of the inner sheath of the rectus, formed by the combined aponeurosis of the transversalis and internal oblique muscles, is used instead of the falx. Frequently considerable tension is made upon this sheath by this procedure. It can be relieved easily by cutting through the rectus sheath as near the median line as possible from the pubis upward for the full length of the inguinal canal. This procedure causes a rather broad gap or defect in this inner part of the rectus sheath. With replacement of the external oblique aponeurosis the rectus muscle is adequately protected. Hesselbach's

triangle is thereby covered by (1) peritoneum, (2) transveralis fascia, (3) lateral expansion of the rectus muscle, (4) conjoined tendon and/or anterior rectus sheath and (5) aponeurosis of the external oblique.

In the past, attempts have been made to utilize the rectus muscle, attaching it either to Poupart's or Cooper's ligament. It has been claimed that the muscle fibers cut out or that they would not unite well with fascial or ligamentous structures. Little or no recognition has been given to the valuable tendinous origin of the rectus muscle. According to Gray's Anatomy, "The rectus abdominus rises by two tendons; the lateral or larger is attached to the crest of the pubis."[4] A further elaboration upon this is made by Paul Eisler.[5] A study of this point has been made upon a number of cadavers at the Anatomy Department of the University of Washington in operating rooms and at postmortems. The following observations have been made: (1) The length of the lateral margin of the tendinous portion of the rectus was on an average of 3.4 cm. The decision as to the upper extent of this tendon was based on the existence of preponderance of tendon fibers over the muscular fibers. This level seemed surgically available and satisfactory for retention of sutures and to meet the specification of tendon-to-tendon application. The length of the tendinous portion of the rectus muscle varied from 1.5 cm. to 4.0 cm. (2) The length along Cooper's ligament necessary to reinforce the defective area, that is, the distance from the lateral free margin of the rectus tendon to the median margin of the femoral vein or the abnormal obturator artery, whichever extended more medially on the pubic pecten, was measured. The range varied from 2.5 to 4.0 cm. In most instances the lateral margin of the rectus tendon was adequate in length to be brought into apposition with this significant portion of Cooper's ligament. We realize that the number of cadavers studied is statistically inadequate to prove this thesis conclusively, but from a practical standpoint it is workable. It is this tendinous

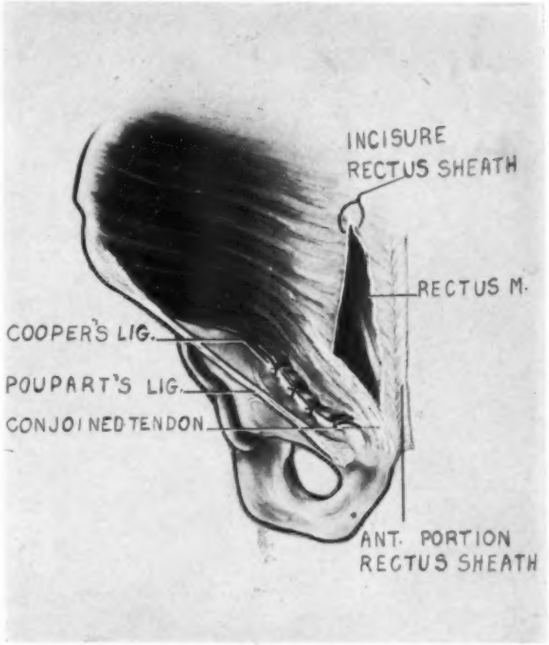

FIG. 4. Conjoined tendon applied to Cooper's ligament; relaxing incision of rectus sheath illustrated. (HOLLOWAY and JACKSON. *West. J. Surg.*, 56: 473–477, 1948.)

portion of the rectus which, it is emphasized, should be attached to Cooper's ligament and its adjacent periosteum. The application of a tendinous structure to a periosteal structure such as that covering the pubic spine or that overlying the iliopectineal line proves eminently more satisfactory than attaching it to a mobile tendinous structure, such as Poupart's ligament, which is without basic support. The application of this principle simulates very closely an actual tendon insertion. An additional advantage is that with one point of attachment firmly fixed and immobile there is no opportunity for sliding, slipping or yielding of approximated soft structures from two directions. Consequently there is much less postoperative edema, discomfort and actual shredding of tissue.

The abdominal cavity is normally supported throughout by muscle tissue as well as fascial and aponeurotic structures. It is a fairly general observation that aponeurosis or fascia alone is not too satisfactory a covering for a body cavity which is under any tension or constant pressure. Very infrequently is a hernia permanently cured

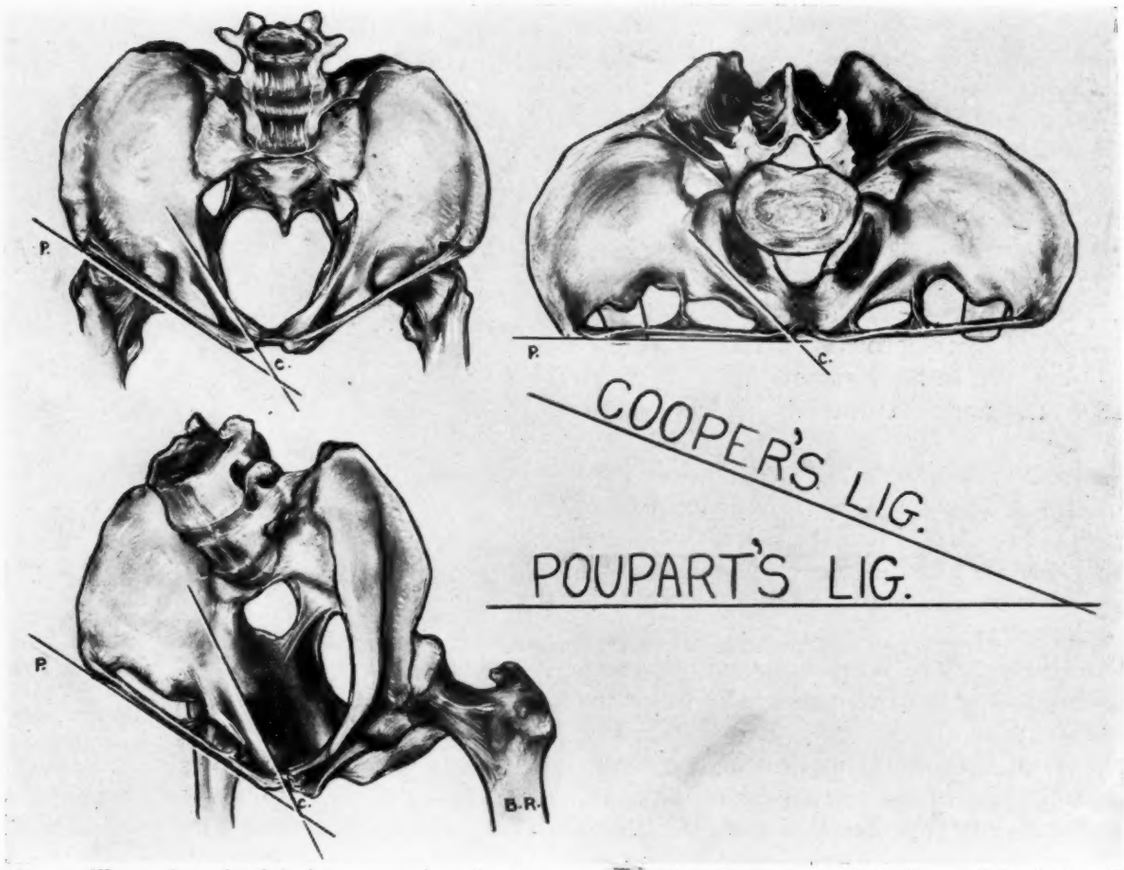

FIG. 5. Illustration of pelvis from several angles demonstrating that the contour of the inner abdominal wall follows the bony margins of the pelvis rather than Poupart's ligament. (HOLLOWAY and JACKSON. *West. J. Surg.*, 56: 473–477, 1948.)

merely by covering the defective area solely with fascia or aponeurosis. We hold that in most instances a better result follows if a layer of muscle fibers is placed over the defect as well as fascia or aponeurosis.

There is a further point which needs clarification. Poupart's ligament is attached to both the pubic spine and the anterosuperior spine. It has been shown that it is a marginal structure loosely attached to surrounding fascia and easily shelled out of its fascial bed to become merely the free margin of an aponeurosis which extends between the anterosuperior spine and the pubic tubercle.[6] Furthermore, in looking at the pelvis from behind it is observed that the contour of the abdominal cavity follows the plane of the iliopectineal line and not the plane of Poupart's ligament. (Fig. 5.) When pressure is made from within the abdoment against Hesselbach's triangle, if a weakness exists, a relatively deep, funnelshaped depression can be demonstrated without altering appreciably the normal convexity of Poupart's ligament.

The operation described is on the whole not technically too difficult to be employed by anyone capable of doing major surgery. There are, it is true, certain steps in the operation for which a definite understanding of the knowledge of anatomy of the inguinal region, careful dissection and adequate exposure are very necessary. The authors do not agree with those who contend that a more simple type of hernial repair should be done by the cross section of surgeons operating upon inguinal hernias. Simply because the Cooper's ligament type of operation offers certain technical difficulties is no excuse for the continued

use of surgical procedures that carry with them ineffectual repair or early recurrence in a relatively high percentage of inguinal hernias.

SUMMARY

1. Anatomically, a more correct reposition of structures can be effected by using Cooper's ligament as an anchor for structures brought down over a defective inguinal triangle.

2. Structurally, a more correct covering for a defect in the abdominal wall is secured by interposition of muscle between fascia and aponeurotic layers rather than by utilizing only fascia or aponeurotic structures. The technic for accomplishing this is outlined.

3. The appreciation and use of the tendinous origin of the rectus muscle offers a new evaluation in reconstructing the floor of Hesselbach's triangle.

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Patterson and Rouse reviewed their twenty-four cases of esophageal varicosities with massive hemorrhage in which the primary form of treatment was the injection of a sclerosing solution into these varices through the aid of an esophagoscope. Their follow-up of these cases indicated that this surgical procedure is of distinct value and that the postoperative incidence of recurring massive esophageal hemorrhages was greatly diminished. (*Richard A. Leonardo, M.D.*)

PHYSIOLOGIC EFFECT OF MASSIVE SMALL INTESTINAL RESECTION AND COLECTOMY*

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THE remarkable fashion in which nature compensates for removal of massive portions of the intestinal tract has always been of great interest to the surgeon. With the advent of improved technics more total and nearly total colectomies are being done for chronic ulcerative colitis, multiple congenital polyposes and megacolon. At times large sections of small bowel are removed for mesenteric thrombosis,[1] segmental ileitis, trauma to major mesenteric vessels and sundry reasons. What effect, if any, is there upon the body economy by such surgical procedures? This question prompted us to make the following general review of the problem of massive intestinal resection and to present the results obtained from a detailed study on two of our patients in this group, namely a man upon whom all but approximately 2½ feet of small bowel was removed and a young girl upon whom a total colectomy was done.

For a review of the anatomy and physiology of the small and large bowel applicable to this problem, special reference is made to the work of Haymond,[2] Treves,[3] Lamb,[4] and Cori and Cori.[5]

There is yet no definite answer as to how much small bowel can safely be removed and still allow the patient to live and return to health. Haymond, in his complete analysis of the problem, concluded from 122 cases of resection that with removal of 33 per cent of small intestine the digestive tract could be expected to return to normal function. Removal of 50 per cent of the bowel constituted the upper limit of safety and above 50 per cent poor results were the rule, although an occasional case would do well. Observations of Flint[6] show that dogs tolerate the removal of as much as 60 per cent of the small intestine. However, they are unable to handle much fat. Apparently, then, it is important to have a certain amount of intestinal mucosa present as well as bile and pancreatic juice.

The effects of colectomy or colonic exclusion, as observed by us on a recent series of five total colectomies and several ileostomies for ulcerative colitis, are similar to those reported by Whittaker and Bargen[7] on a series of forty-five cases.

For approximately one month following colectomy or exclusion of the colon there is a period of metabolic adjustment during which time the patient appears to do poorly. The excreta from the ileostomy or rectum (iliosigmoidostomy having been done) move almost constantly, being approximately 90 per cent water; the physical or mental attitude of the patient is very poor; examination of the blood shows some reduction in serum calcium which returns to normal within a month and some reduction of chlorides[8] but no gross disturbance of the equilibrium of the chemical constituents of the blood. After the first month there is an increase in strength and weight and within two to three months these are practically normal. The watery discharge thickens so that within a short period of time the stools are soft and occasionally formed.

It is the general opinion that no permanent deficiencies in metabolism occur following colectomy or colonic exclusion.

CLINICAL OBSERVATIONS

The following two cases typify the findings in patients upon whom massive small

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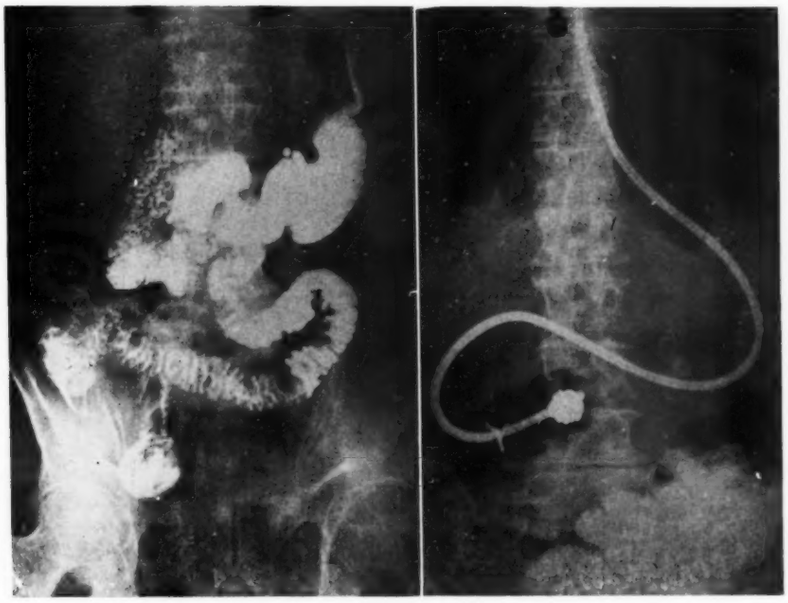

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FIG. 1. Length of small bowel; approximately 38 inches.
FIG. 2. Site of intestinal anastomoses.

intestinal resection was performed (Case 1) and following colectomy (Case 11):

CASE 1. G. O., a white male aged sixty-one, was admitted to Mercy Hospital, Pittsburgh, Pennsylvania, on October 14, 1946, with aching pain in the right lower abdomen and right flank. He had had one episode of nausea and vomiting about two weeks previously but was in no acute distress. A large, firm mass could be palpated in the mid-abdomen. X-ray examination showed the mass to be extrarenal and extracolic. It was believed that he had a retroperitoneal tumor. On October 24th the abdomen was explored and a retroperitoneal lymphosarcoma was found in the mesentery of the small bowel. This necessitated removal of a massive segment of small bowel due to the fact that the tumor extended into the root of the mesentery thus impinging on a major portion of the blood supply. An end-to-end anastomosis was performed between the terminal foot of ileum and the third portion of the duodenum several inches proximal to the ligament of Treitz. This was accomplished by severing the ligament and dissecting the retroperitoneal duodenum so as to make the anastomosis. Postoperatively, his fluid and electrolyte balance were maintained with intravenous infusions; also, protein and vitamin supplements were administered. He was given a course of deep x-ray therapy and was discharged on November 11th. His prognosis was guarded because it was realized that he had approximately only 2 to 2½ feet of small bowel remaining.

In August 1948, he came into the hospital so that the metabolic effects of having only approximately 38 inches of small bowel from pylorus to cecum as measured on x-ray film could be studied. (Fig. 1.) It was interesting to note that hypertrophy and elongation of the intestine had taken place. At the time of operation the terminal ileum was pulled straight up to the duodenum with no loops of small intestine interposed, as shown on the x-ray picture. The marked hypertrophy of the lumen of the small bowel may also be observed in the same picture. This is most noticeable in the segment of small intestine filled with barium which resembles the transverse colon. Apparently, both a compensatory elongation and hypertrophy had resulted. Figure 2 demonstrates the site of anastomosis at the tip of the inserted Miller-Abbott tube. The tube could be inserted no further because of narrowing and stricture at this point, not sufficient to cause the patient distress. Aside from a normocytic anemia his blood and blood chemistry were essentially normal. (Table 1.)

Of great interest were the fecal fat determinations. (Table 11.) The patient was given

a high fat diet (fat 150.55 gm., carbohydrates 159.7 gm. and protein 76.3 gm.) and three samples of feces were examined. The percentages of fat (which is the summation of neutral fat and fatty acids,) 7.3 per cent, 4.12 per cent and 12.18 per cent, all fall within the normal values as given by Fowweather[9] which are

Subjectively, this man believed that the only thing different about him was that he was "almost always hungry" and that he ate more often. He maintained a constant weight of 140 pounds during the previous year and was working and feeling well in December, 1948.

TABLE I

	Glucose Tolerance Test	Total Proteins (mg. %)	Albumin Globulin	Non-protein Nitrogen (mg. %)	Blood Urea Nitrogen (mg. %)	Cevitamic acid (mg. %)	Creatinine (mg. %)	Chlorides Blood (mg. %)	Prothrombin (%)	Blood Count	Calcium (mg. %)	Phosphorus (mg. %)
Case I	Fasting .92 45 min. .129 2 hr. .126	7.62	3.80 3.82	51.3	...	0.8	1.7	526	92	r.b.c. 3,350,100 w.b.c. 6,780 hb. 9.56 gm	....	...
Case II	Fasting .101 45 min. .135 2 hr. .71	6.73	4.90 2.83	23.6	7.1	1.0	1.2	466	89	r.b.c. 3,980,000 w.b.c. 5,650 hb. 9.5 gm.	10.8	4.4

neutral fat 7.3 per cent and free fatty acids 5.6 per cent.

Barium reached the large bowel approximately one hour following its ingestion at this time. A fluoroscopic examination several months following the operation showed the barium to reach the cecum within ten seconds. Iron tablets taken with a meal gave a tarry stool approximately six to eight hours after eating. He noted that the eating of such things as beets and greens similarly discolored the stool in this length of time. He averaged three to four softly formed stools in twenty-four hours.

TABLE II*

	Case I			Case II		
Stool Sample	1	2	3	1	2	3
Weight of feces in sample (gm.)	10.82	12.87	1.56	78.1	77.50	7.50
Weight of total fat in sample (gm.)	0.79	9.53	0.19	0.90	0.60	1.59
Per cent of fat in sample	7.30	4.12	12.19	1.15	0.77	2.12

* Fat determination by University of Pittsburgh Department of Chemistry.

CASE II. G. B., a white female aged fourteen, came into this hospital on August 10, 1947, with typical Hirschsprung's disease which she had since birth. (Fig. 3.) The entire colon proximal to the sigmoid was tremendously dilated and there had been no response to prolonged medical therapy. On August 28th a subtotal colectomy was done which brought the terminal ileum and sigmoid out through the abdomen in the fashion of a Mikulicz procedure. The resected colon, together with its fecal contents, weighed 20 pounds. Following surgery the patient spent about a month passing through the stage of debilitation mentioned previously; there was almost a constant flow of liquid material from the ileostomy. She began to improve; the abdominal opening was closed and she was sent home on December 25th.

On July 19, 1948, she returned to the hospital in good health (Fig. 4) for the metabolic studies shown on Table II. She also was placed on a high fat diet as was the patient in Case I (fat 150.55 gm., carbohydrates 109.7 gm. and protein 71.3 gm.) and the percentages of fat in her stool were much lower than in the first patient. She had approximately three to five liquid to semi-soft bowel movements a day although for two to three months following the operation this number was nine to twelve. Feosol® tablets ingested with a meal resulted

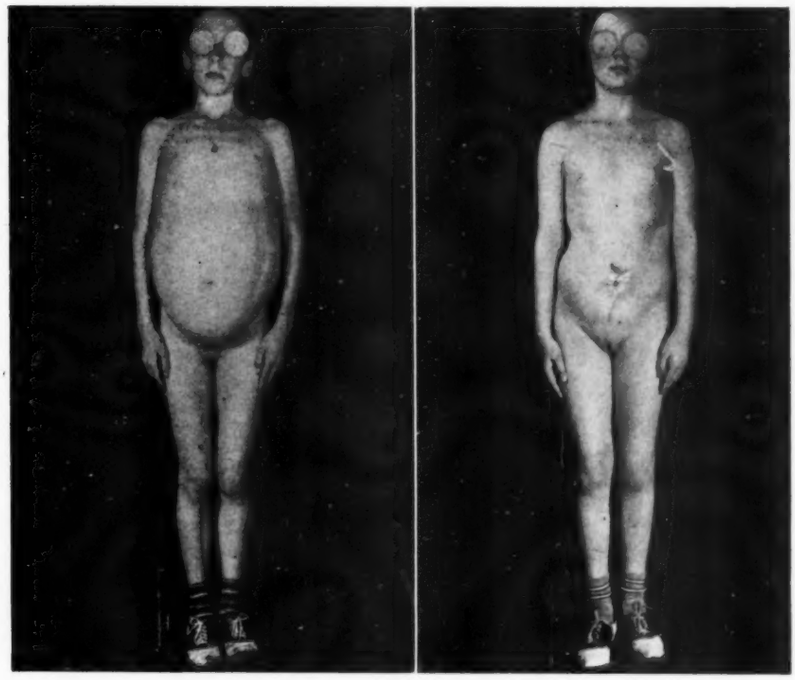

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FIG. 3. Before colectomy.
FIG. 4. After colectomy.

in a tarry stool seven hours and forty-five minutes later. Her blood calcium level was normal, apparently having become adjusted to the colectomy.

Of special interest was the discrepancy of urinary output as compared with measured intake. On three successive days her intake by mouth was 1,300 cc., 1,850 cc. and 1,350 cc. Her urinary output was 500 cc., 800 cc. and 800 cc. No record was kept of total volume of feces which were liquid. However, as she appeared clinically to be in normal water balance, it might be presumed that the urine volume was less because of water loss in the feces.

SUMMARY AND CONCLUSION

Nature's ability to compensate for tissue loss is demonstrated in massive removal of portions of intestinal tract just as in the removal of part of numerous other organs of the body. Two cases upon which rather detailed study was done following resection of all but 38 inches of small bowel and a subtotal colectomy were presented with the following tenable conclusions:

1. Massive resection of small bowel is physiologically feasible in an unpredictable number of cases and, therefore, should be done when it may be life-saving, i.e., mesenteric thrombosis, tumor.

2. Although all but approximately 2 to 2½ feet of small bowel were removed at operation, compensatory elongation and hypertrophy have taken place so that two years later there are about 38 inches demonstrable by x-ray.

3. By chemical and laboratory examination no serious metabolic derangement has occurred in a man upon whom all but 2 to 2½ feet of small bowel were removed. This is admittedly very unusual.

4. Colectomy or colonic exclusion is attended by immediate serious metabolic derangement.

5. Several months following colectomy the chemical and laboratory studies are essentially normal.

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PANCREATIC calculi were first described by DeGraaf in 1667; only 250 cases have since been reported. The condition is probably not rare but is frequently overlooked or forgotten. This possibility should be suspected in diabetics with abdominal pain or steatorrhea, or those with enlargement of the liver and associated vague pains in the upper abdomen. One characteristic of this epigastric pain is that it is often spasmodic and colicky in character, severe in intensity and may radiate to the left side of the abdomen to the back and to either shoulder, especially the left one. The indicated treatment is surgery but only in cases in which the pancreatic calculi are apparently causing severe enough symptoms to warrant taking such risks. There should be no operation for the so-called "silent" stones in the pancreatic ducts which are accidentally found by x-ray examination and are not causing symptoms. (*Richard A. Leonardo, M.D.*)

ANALYSIS OF THE MECHANICAL PRINCIPLES AS APPLIED IN TRACTION OF FRACTURES OF THE FEMUR

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APPLICATION of traction serves a twofold purpose in fractures, namely, reduction of a pathologic position and maintenance of proper alignment of fragments during the process of healing.

Under normal conditions simultaneous contraction of agonists and antagonists inhibits the motion of a joint. The two muscle groups neutralize each other and this results in a stabilizing effect. A fracture, however, does create a new joint in which the leverage is altered, whereas origin and insertion of the two muscle groups remain unchanged. Therefore, they can no longer balance each other. Their tonus, traumatically stimulated, causes angulation or displacement.

The conventional method of traction uses weights which are fastened over pulleys to the distal fragment either by adhesive tape or by a Kirschner wire or similar pin. The weight exerts a pulling force on the distal fragment while the proximal one is stabilized by the body weight. The hip and knee are flexed; the whole leg is elevated and supported by a splint. A constant pull keeps the two fragments in proper alignment.

This method may be analyzed as to its mechanics if the following substitutions are made (1) for the proximal fragment, a body A; (2) for the distal fragment, a body B; (3) for the muscles connecting the two fragments and running across the fracture, an elastic connection between the body A and the body B.

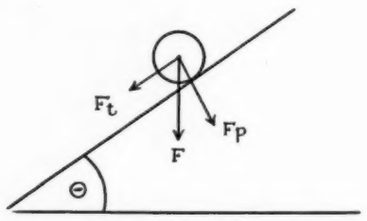
If a body rests on a horizontal plane, gravity exerts only one force, perpendicular to the support. The force is proportional to the weight of the body. However, if the supporting plane is raised on one side to an angle θ, the force of gravity may be resolved into two components, one force tangenital to the slope (F_t) and another force perpendicular to the same (F_p). (F_t = Weight $\times$ Sinus θ; F_p = Weight $\times$ Cosinus θ.) See Figure 1.

For the following analysis traction applied to a fracture of the middle thigh is taken as an example:

Two separate bodies A and B, elastically connected, are supported on an inclined plane. A pulling force (F) is attached to the body B. The force is transmitted through the connection to body A which, being fixed to the support, acts against the pulling force. The elastic connection under stretch (F_e), the tangenital action of gravity on body B (F_t) and friction (F_f) between body B and support are all three antagonistic to the force F. Therefore, a pulling force F must be equal or greater than F_e, F_t and F_f to maintain equilibrium or to move body B up on the inclined plane ($F = > F_e + F_t + F_f$). (Fig. 2.) The force of the elastic connection equals a constant times elongation (F_e = K $\times$ elongation). Friction depends on the perpendicular force of gravity on B (F_p) and on the coefficient of friction of the two surfaces in contact (lower surface of B and the support) ($F_f = F_p \times \mu$). It follows from this consideration that not the whole force F produced by the pulling weight but only a certain part of it (F_e) is effective at the elastic connection. The rest is used up in equalizing F_t plus F_f but body B is subjected to the whole force F ($F_e = F - F_t + F_f$).

The last equation offers an explanation for some of the poor results in individuals with very strong muscles. F_e being smaller than F might have been too weak to overcome satisfactorily muscle power responsible for angulation or displacement. How-

ever, F might have been too strong for the tissue. F acts on the skin through the adhesive tape or on the bone through the pin. If this force is too great, it interferes with the necessary blood supply in this area; and after such prolonged treatment necrosis may result. Therefore, the amount of traction that can be applied to the distal fragment is limited. Textbooks recommend 20 pounds.



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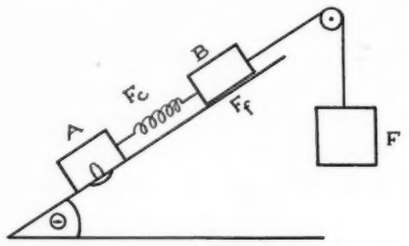

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FIG. 1. θ = angle of inclined plane; F = force of gravity; F_t = component of F tangential to slope; F_p = component of F perpendicular slope.
FIG. 2. θ = angle of slope; A = body secured to slope; B = body sliding on slope; F_e = force at elastic connection between A and B; F = weight exerting a pulling force; F_f = force of friction between body B and slope.

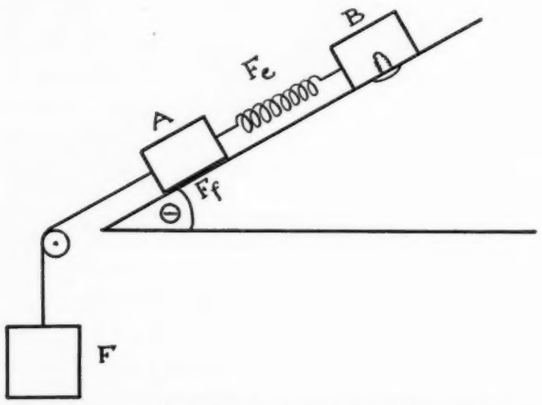

FIG. 3. θ = angle of slope; A = body sliding on slope; B = body secured to slope; F_e = force at the elastic connection between the two bodies; F_f = force of friction between body A and slope; F = weight exercising a pulling force.

In the Bryant and Le Mesurier method used in children the proximal fragment is pulled away from the distal one which is fixed. This method reverses the principle on which the previously described technic is based and which is in common use for treatment of fractures of the femur in adults. (Fig. 3.)

To analyze the mechanics of the reversed principle we make the same substitutions as before. Again body A and B elastically connected rest on an inclined plane which has the same angle θ. This time the pulling force F′ acts on A and is transmitted through the elastic connection to B which is fixed. Again we calculate the effective force F'_e at the connection.

In order to facilitate a comparison of the two mechanical principles—B being pulled away from A and A being pulled away from B—the following tables have been computed for arbitrary figures under identical conditions:

Pulling force F	20 lb.
Weight of body A	10 lb.
Weight of body B	10 lb.
Coefficient of friction (μ)	0.1 and 0.001*

* The coefficient of friction equals the tangent of the angle θ at which a body starts to glide. μ was experimentally determined for the skin gliding on a sheet. The method used to that effect was the following, namely, an undressed person was put on a board to which a sheet was fastened. The board was raised on one side gradually to an angle of 30 degrees when the person started to glide. Tangent of 30 degrees is 0.57. However, it was noticed that the person moved under the skin already at an angle of 10 degrees corresponding to a tangent of 0.17. Some movement took place before the skin moved because the skin is loosely connected to the subcutaneous fat and the muscles. The friction, therefore, between the tissues is less than the friction between the skin and the sheet. For this reason we assumed μ to be 0.1 because some movement occurs at the place of fracture before the skin of the distal fragment moves.

Table 1 gives the values of the effective force (F_e) for two coefficients of friction $\mu = 0.1$ and $\mu = 0.001$ at various angles θ for a constant pulling force of 20 pounds. It

also gives the quotient F_e over F at various angles θ again for $\mu = 0.1$ and $\mu = 0.001$.

A practical example is:

To obtain $F_e = 10$ lb. at an angle $\theta = 30°$ for $\mu = 0.1$

15.87 lb. are required if F is applied to B but only

5.87 lb. are required if F is applied to A for $\mu = 0.001$ the values are 15.01 lb. and 5.01 lb., respectively.

first requirement. However, F_f can be reduced considerably if the supporting splint is constructed in a special way. The splint is divided at the place of fracture. One part of it is provided with rollers and supports whichever fragment is supposed to move; the other part is stationary. The coefficient of friction in this case in which rollers roll on metal is about 0.001.

Table 1 shows F_e over F to be close to the

TABLE 1

$\mu = 0.1$

Angle θ	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	90°
F_e	19.00	18.13	17.29	16.45	15.64	14.87	14.13	13.45	12.81	12.22	10.00
$\frac{F_e}{F}$	0.90	0.90	0.86	0.82	0.78	0.74	0.70	0.69	0.64	0.61	0.50
F'_e	19.00	19.87	20.75	21.51	22.48	23.31	24.13	24.91	25.65	26.36	30.00
$\frac{F'_e}{F}$	0.90	0.99	1.03	1.07	1.12	1.16	1.20	1.24	1.28	1.31	1.50

$\mu = 0.001$

Angle θ	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	90°
F_e	19.99	19.12	18.26	17.41	16.57	15.77	14.99	14.26	13.57	12.92	10.00
$\frac{F_e}{F}$	0.99	0.95	0.91	0.87	0.83	0.79	0.75	0.71	0.68	0.65	0.50
F'_e	19.99	20.86	21.72	22.57	23.41	24.21	24.99	25.78	26.41	27.06	30.00
$\frac{F'_e}{F}$	0.99	1.04	1.09	1.12	1.17	1.21	1.24	1.28	1.32	1.35	1.50

Table 11 shows the relation of F_e and F'_e, respectively, to the weight creating the force of traction F to angle θ and to the force of friction F_f.

TABLE 11

F_e	Direct proportional to F Inversely proportional to angle θ Inversely proportional to F_f	Direct proportional to F Direct proportional to angle θ Inversely proportional to F_f	F'_e

A method of traction in order to be ideal would have to satisfy two requirements: ($F_f = 0$; $\frac{Fe}{F} = 1$ or greater than 1). Obviously, no practical method can satisfy the first requirement. However, F_f can be reduced considerably if the supporting splint is constructed in a special way. The splint is divided at the place of fracture. One part of it is provided with rollers and supports whichever fragment is supposed to move; the other part is stationary. The coefficient of friction in this case in which rollers roll on metal is about 0.001.

Table 1 shows F_e over F to be close to the value of 1 or to be greater than 1 (as in the last equation) if the proximal fragment is pulled away from the distal one. In any case a certain percentage of the pulling force is gained (the amount depends on the value of F and the angle θ) if the support is divided and the movable part is put on rollers. Thus F_e becomes equivalently greater.

If this analysis is applied to actual conditions in which the pulling force F acts on the distal fragment, two more factors have to be considered:

1. As force F is pulling up the lower fragment, the pin also carries part of the weight of the lower leg (resting on the horizontal section of the splint).

2. Coefficient of friction between the splint and the distal fragment is closer to the value of 1 than to the value of 0.1 (confirmed by experimental tests).

Factors 1 and 2 reduce the effective force F_e at the fracture. In computing Table 1 both factors were disregarded. If they are taken into account, the ratio $\frac{F_e}{F}$ would be smaller, whereas $\frac{F'_e}{F}$ would be greater than shown in Table 1.

Figure 4 illustrates a modification of the sliding frame constructed for spine traction by one of the writers. This device also operates with a coefficient of friction of approximately 0.001. It can be adapted to the treatment of fractures of femur, pelvis or spine regardless of the patient's age. The distal fragment is fixed and the proximal one is pulled away by gravity. However, the gravitational pull would be too great because the upper body is connected with the proximal fragment. In order to reduce the pulling force to the required amount a variable weight exerts a force in the opposite direction.

SUMMARY

Two methods of traction are mechanically analyzed; gravity acts against the pulling force in one method but with the pulling force in the other one. It is shown by tables that the force of traction at the place of the fracture is greater when gravity assists the pulling force. For this technic of traction new special apparatuses are suggested.

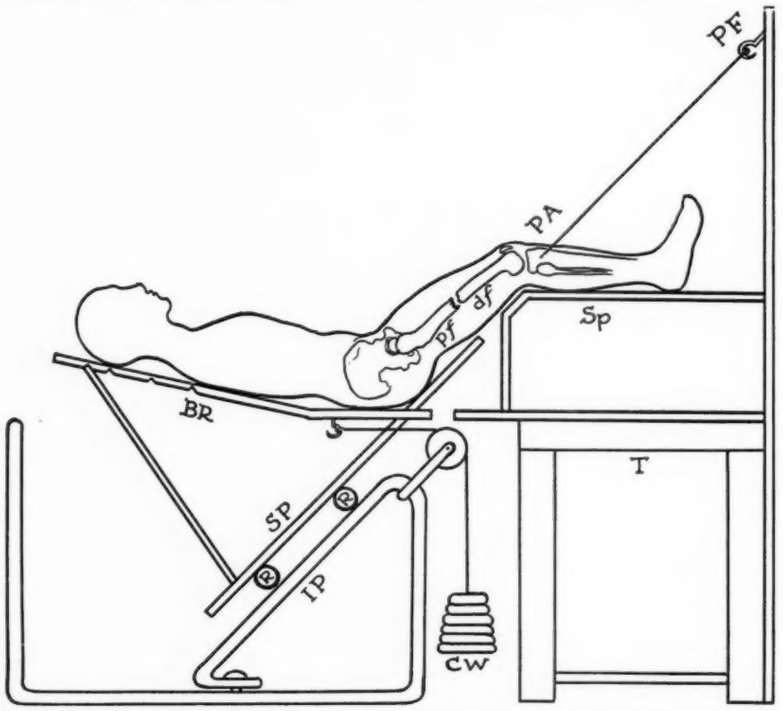

FIG. 4. IP = inclined plane (fixed in position); RR = rollers; SP = sliding plane; BR = back rest (adjustable); pf = proximal fragment; df = distal fragment; pf = point of fixation; PF = point of fixation; PA = point of attachment; *T* = table; SP = support; CW = counterweight.

Acknowledgment: We wish to express our sincere thanks to Professor Dudley D. Fuller, Columbia University, Mechanical Engineering Department, for his valuable help and supervision.

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EARLIER diagnoses and prompt surgery are the only measures that will effectively reduce the mortality of acute intestinal obstruction, especially of the small bowel. The higher the obstruction the more serious is the case, especially if neglected. Surgeons must realize that fecal vomiting is an extremely late symptom; not only must they not wait for that but also they must realize that acute obstruction can occur in the absence of constipation and obstipation. It occasionally happens that these patients may have diarrhea or apparently normal bowel movements and the normal passage of flatus rectally. This is true because with higher small bowel obstructions there may be a considerable amount of fecal material distal to the obstruction which passes through the anus as usual. A flat plate or scout roentgenogram of the abdomen is the one most important procedure which must never be omitted in making a differential diagnosis. Most neglected or misdiagnosed cases became such because the attending practitioner forgot to order x-rays or did not realize their value. Formerly we resorted to operative enterostomy in the supplemental therapy of many of these cases in addition to correcting the mechanical cause of the intestinal obstruction. Since the advent of intestinal intubation through the nose, however, surgeons will find it rarely necessary to resort to operative enterostomy in addition. However, the Miller-Abbott or other tube used must be properly introduced, and one must make sure it progresses well down into the small bowel; otherwise only incomplete intestinal decompression will result. (*Richard A. Leonardo, M.D.*)

MALIGNANT MELANOMA*

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MALIGNANT melanoma is not a common neoplasm, yet its occurrence in any individual foreshadows a lethal outcome unless adequate therapy is rapidly accorded the patient. The recent occurrence of two such cases at the Meriden Hospital, a general hospital of 176 beds, prompted an analysis of its records to determine the incidence of this disease. A critical analysis of the records of this institution with respect to malignant melanoma may well reflect the existing situation in the majority of hospitals of this size and in addition points out the tragic plight of afflicted patients under any inadequate and temporizing mode of therapy. While reports of this nature usually stem from larger hospitals and teaching centers, a report from a smaller hospital consisting of sixteen cases if not beneficial will at least be informative.

SUMMARY OF CASES

From 1935 through 1948 eighteen cases of malignant melanoma have been encountered, fifteen of which had their primary site of origin in the skin. In two instances the eye was primarily involved and in one case the primary site of origin was undetermined. Table 1 lists the individual cases and records the relevant information obtained from their respective charts. Only cutaneous melanomas are considered in this study.

The youngest patient in our series was thirteen and the oldest seventy-three years of age, ten of the patients having attained an age of forty-five or more years. The average age was forty-nine years. There were nine females and seven males and all belonged to the white race.

In fifteen instances a history of a pre-existing mole or nevus as the primary site was recorded. The primary site was on the lower extremity in five cases, on the head and neck and on the upper extremity in three cases each and on the trunk or torso four times.

Ten of the patients gave a history of prior removal of a nevus, usually in a physician's office. In five instances the manner in which removal was accomplished was not stated. Electrocautery was used on three patients, local excision on one and the radium needle on another. The charts did not contain sufficient information in thirteen instances to permit a definite statement regarding clinical evidence of malignant change in the pre-existing nevi. Only three patients are recorded as having complained of bleeding, ulceration, pain or an increase in size of their nevi.

Surgical treatment (other than that designated as previous removal) was rendered to thirteen patients, which consisted of an array of procedures. In three instances local excision of an involved nevus was performed and in a fourth case removal of the regional nodes was accomplished at the time of local excision. In two additional cases resection of clinically enlarged regional nodes was done at some time subsequent to the removal of the cutaneous melanoma. Local excision of local recurrences resulting from inadequate previous removal was done in two instances while this procedure plus removal of involved regional nodes were performed in two other cases. In two instances the surgeon resorted to amputation of an involved lower extremity. In one case in which the primary site of origin was undetermined the first indication of a pathologic condition was the presence of a mass in the right cervical region, which when

* From the Lucy A. Peck Laboratory of the Meriden Hospital, Meriden, Conn.

removed and examined histologically provided the diagnosis of "metastatic malignant melanoma." Treatment of this case consisted of removal of the mass. Three patients received no treatment because of widely disseminated metastases at the time of admission.

Death has claimed the lives of eleven patients in our series, the average survival time being 30.9 months after the patients first sought treatment. The shortest survival in this group was three months and the longest six years.

Five of the patients are alive at the time of writing, two of them without clinical evidence of recurrence four and a half years after surgical treatment (Cases 8 and 9). One of these, a patient in whom enlarged axillary nodes appeared after removal of her primary lesion via electrocautery, was subjected to resection of these nodes. Wide local excision was accorded the other patient. Two patients are alive but ill with metastases one and three years after the onset of the disease, both of whom had regional node resection after obvious metastases had occurred. The one patient whose presenting complaint was a mass in her neck is alive four months after removal but her prognosis must be considered as grave.

The diagnosis of malignant melanoma in

TABLE 1

SUMMARY OF RELEVANT INFORMATION IN SIXTEEN CASES OF MALIGNANT MELANOMA

Case	Age (yr.)	Sex	Primary Site	Previous Removal	Treatment	Survival after Onset of Disease
1	67	F	Left big toe	No	Local excision	Dead 2 yr.
2	47	F	Mole on left mid-thigh	No	Local excision	Dead 7 mo.
3	66	F	Midline of back; lump in right axilla	Radium needle by physician several times in 2 yr.	Local excision of recurrence; later removal of involved axillary nodes	Dead 3 yr.
4	72	M	Sole of right foot	Yes; manner not stated	Mid-thigh amputation	Dead 6 yr.
5	56	M	Right ear	Yes; manner not stated	No treatment	Died while in hospital
6	54	M	Over right scapula	Yes; excision	Repeated excisions of recurrence	Dead 5 yr.
7	73	M	Left cheek	Yes; electrocautery	Wide excision of local recurrence	Dead 3 yr.
8	13	F	Left arm	Yes; electrocautery	Removal of cautery scar and 2 enlarged axillary nodes	Alive without recurrence 4½ yr.
9	30	F	Right leg	No	Wide excision	Alive without recurrence 4½ yr.
10	45	M	Left wrist	Yes; manner not stated	Removal of involved axillary glands 2 mo. after removal of wrist lesion	Dead 1½ yr.
11	43	M	Left foot	Yes; electrocautery	Amputation left foot	Dead 5 yr.
12	68	M	Right temple	No	No treatment	Had extensive metastases; dead 3 mo.
13	30	F	Lump in right neck; no primary	No	Removal of mass	Alive with recurrence 4 mo.
14	38	F	Skin of back near right costal margin	Yes; manner not stated	Had extensive metastases; no treatment	Dead 2 yr.
15	22	F	Mole on back	Yes; manner not stated	Axillary resection 9 mo. after removal of mole	Alive with recurrence 1 yr.
16	64	F	Left arm	No	Local excision plus left axillary disecction	Alive with recurrence 3 yrs.

each case of this series is substantiated by histologic examination of either the primary cutaneous melanoma or a metastasis. Ten of the lesions were amelanotic melanomas, growing in an alveolar pattern. The remainder were pigmented and showed various patterns from alveolar to spindle cell in type. It is known that in at least three of the cases, nevi removed in physicians' offices did not have the benefit of microscopic examination, but the subsequent metastases did.

TABLE II

PERTINENT DATA FROM TWELVE SERIES OF MALIGNANT MELANOMA REPORTED IN THE LITERATURE

Author and No. of Cases in Series	Presence of Pre-existing Nevi	Previous Removal by Physician	Type of Treatment	Survival Rates
Ackerman[1] 75	61%	No statement	Radical surgery	Over-all 5-year salvage = 19%
Adair[2] (Pack and Livingstone[3]) 400	Over 50%	10% by electrodesiccation	Surgery and x-ray	267 cases followed-up 5 or more years; over-all 5-year salvage without recurrence = 14.5%
Affleck[4] 317	83%	No statement	Surgery	170 cases followed-up 5 or more years; 115 dead less than 3 years; over-all 5-year salvage = 11%
Bloodgood[5] 200	No statement	No statement	Electrocautery and surgery	1 patient lived 5 years
Butterworth and Klauder[6] 50	100%	No statement	Surgery and x-ray	40 cases followed-up, 8 of them for less than 3 years; 25 dead on average of 31 months; 6 alive 41–101 months
Darland and Holmes[7] 174	54 cases	9 cases	Surgery and x-ray	82 cases followed-up 5 or more years with 15 patients attaining 5-year survival (18% over-all 5 year-salvage)
DeCholnoky[8] 117	No statement	4.3% by electric needle	Surgery	A selected group of 26 patients reported with a 5-year survival of 42.3%
Driver and MacVicar[9] 60	80%	Mentioned but no percentage given	Surgery, electro-surgery, x-ray and radium	Over-all 5-year survival of 60 patients = 32%
Pack et al.[10] 862	50%	64%	X-ray and surgery	Over-all 5-year salvage = 9.7%
Taussig and Torrey[11] 35	"Many"	No statement	Surgery, electrodesiccation and x-ray	7 patients known to be alive and well 5 or more years after treatment = 20%
Webster et al.[12] 162	65%	24%	Surgery	No statement

PRESENT STATUS OF MALIGNANT MELANOMA

Table II summarizes some of the pertinent data procured from the literature on cutaneous malignant melanoma. This term includes those neoplasms designated as melanocarcinoma, melanosarcoma, nevocarcinoma, melanoepithelioma and melanoblastoma. The skin is the most common site of origin for the malignant melanoma, but primary growths of this nature occur in other melanin-producing areas such as the mucous membranes, the choroid layer of the eye, the meninges, the choroid plexus of the central nervous system, the ovary, the gallbladder and the adrenal gland.[6,13] Its presence in the skin may be as a primary neoplasm or may be secondary to a pre-existing mole or nevus, instances of the latter varying from 50 to 100 per cent depending upon the series reported. The relative incidence of this neoplasm is low when considered in terms of the total number of malignancies; it is reported to constitute from 0.89 to 2 per cent of all neoplasms and 20 per cent of the malignant tumors of the skin.[3,6] In

Connecticut recent data reveal that 0.93 per cent of all cancers are of this nature.[14] In spite of its rarity malignant melanoma constitutes the most common tumor of the lower extremity.[1]

Age. No age group can claim immunity to malignant melanoma although children before the age of puberty are often spared the ravages of this disease. In the series of 862 cases of Pack et al.[10] the youngest patient was four months and the oldest eighty-six years, the preponderance of cases occurring between the ages of thirty-five and seventy. In several series the average age was found to be just under fifty years.[6,8,11]

Sex. The occurrence of malignant melanoma is about evenly divided between the two sexes although some series show a slight predominance in favor of either males[1,6] or females.[8] Negroes are much less prone to develop this disease than are whites.

Malignant Activity within a Nevus. Evidence of malignant activity within a nevus or mole usually expresses itself by an increase in size, alteration in color (especially increased pigmentation), pain, bleeding, ulceration or induration. Hairy moles seldom undergo malignant change. In as many as 10 per cent of the cases, however, an enlarged regional node due to metastases may be the first indication that a mole is the site of a malignant melanoma.[1]

The relationship between factors such as trauma and irritation and the development of malignant activity in moles is not entirely clear. The incidence of malignant melanoma arising in nevi is proportional to the amount and extent of chronic trauma to which these structures are exposed. This is illustrated by the fact that the lower extremity, particularly the foot, has the highest incidence of all regions, head and neck and torso following in this order.

The inappropriate treatment of moles by physicians has been indicted as a direct predisposing factor to malignant change in these structures.[2,15] Needling, electrocautery and electrodesiccation, the use of carbon dioxide snow, chemicals and pastes have all been duly accused. Inadequate and partial removal of moles have been vigorously attacked and the recurrence or appearance of satellite lesions at the site of local excision of a lesion have been laid directly responsible to these factors.

Treatment. The progression of malignant melanoma is very rapid, and all too frequently there are distant or regional metastases at the time the patient presents himself for treatment. Distant metastases preclude anything but palliative measures while regional metastases considerably reduce the prospects of survival under any type of therapy.

The early, radical surgical treatment of malignant melanoma at present is accepted by most authors to be the treatment of choice providing metastases to distant areas has not already occurred. The local lesion should be treated adequately and vigorously. Pack et al.[10] recommend that "at least 6–10 cm. of skin border, and a still wider circle of deep fascia should be removed en masse with the primary tumor. In the majority of cases, primary skin grafting is required to close the defect."

The problem arises as to whether or not the dissection and removal of the regional lymph nodes into which drain the lymphatics from the area involved should be attempted. Of course, any concomitant or subsequent enlargement of the regional lymph nodes must be assumed to be on a metastatic basis until proven otherwise, and here the indication for surgical resection is clear. The experience of Pack and Livingston,[3] however, cannot be underestimated, namely, that minute foci of metastatic melanoma clinically undetectable were found in over 50 per cent of the regional nodes removed routinely in their series. In some clinics, dissection and removal of all intervening lymphatics, fat and fascia in addition to the local lesion and the regional nodes are carried out.[16]

The electrosurgical removal of potentially malignant moles or suspicious local lesions utilizing electrocautery and electrodesiccation is advocated by some [5,6,17] and condemned by others.[1,2,12,15] Driver and

MacVicar[9] and others assume a middle-of-the-road course, stating that the mode of removal, whether by electrocautery or scalpel excision, is not important providing the removal is thorough and prior to the occurrence of metastases. It is apparent, however, that adequate removal of a fair-sized nevus would give rise to a rather unsightly, granulating defect in the tissue subjected to electrocautery procedures; if it did not, the removal could not be considered adequate. In addition, the mole is frequently destroyed in this process, thereby preventing histologic examination.

At present it is generally agreed that radiation therapy of malignant melanoma is of no value[1,3,10,12,18] although Anderson and Simpson[19] in 1935 believed it to be superior to all other forms of therapy and Delario[17] recently reported one case of apparent cure using this method. Only 2.5 per cent of Adair's[2] cases showed any response to x-ray and Pack et al.[10] conclusively demonstrated the ineffectiveness of this therapy. Ackerman[1] presents photomicrographs that show viable tumor cells of a malignant melanoma after tolerable doses of irradiation, which well illustrate the uselessness of roentgen therapy.

The prophylactic removal of nevi is a subject that deserves serious consideration. The removal of all nevi from the body for such a purpose is neither desirable nor rational. It has been found that the average person has at least twenty pigmented moles.[2,3] At present, the consensus among most authors is that those nevi whose position subjects them to continual trauma, irritation or rubbing should be removed along with a generous margin of healthy tissue;[1,2,6,8,9] otherwise nevi should be left alone if no evidence of malignant change is apparent. One fact cannot be overemphasized, however; if removal is to be accomplished, it should be done thoroughly and adequately.

When the survival rates of twelve series of malignant melanoma (Table II) are examined, the poor prognosis of this disease becomes apparent. These figures are expressions of over-all five-year or more arrests, unless otherwise indicated. If, however, as most authors have done, the series are broken down and the hopeless cases are separated from those eligible for a chance to survive, the statistics become more encouraging. The series of Driver and MacVicar[9] serves to illustrate one of the most favorable of such reports. Of sixty patients, twenty-five were seen and treated late and thirty-five early in the course of the disease. Of the former, only two survived five years or more after treatment. There were seventeen patients in the second group who lived seven to eighteen years without recurrence after treatment, representing a survival rate of 56.7 per cent for this group.

Patients are on record of having survived twenty and twenty-six years[6] after therapy but are noteworthy only for their rarity.

COMMENTS

It is evident from the foregoing paragraphs that the present management of malignant melanoma leaves much to be desired. The more recent reports indicate a trend toward a greater salvage rate. This is due in large part to the early undertaking of radical and adequate surgical measures.[10,16]

It is difficult to evaluate malignant activity within a pigmented mole or nevus in terms of trauma. Trauma may be the agent that first brings evidence of malignant change in a nevus to a patient's conscious level. Likewise is the role of the physician difficult to evaluate who removes these structures via electrocautery. There must be many, many moles and nevi removed in this manner by physicians without untoward effect for each instance of malignant melanoma that is seen in the hospital subsequent to such removal. Chronic irritation of a nevus by a shoe, collar, comb, etc., should be given serious consideration as a predisposing factor to malignant change.

It is not necessary to dwell at length upon the importance of early adequate treatment, but its significance cannot be overemphasized. Suffice it to say that to

temporize with this neoplasm or to treat it with any but adequate and vigorous surgical procedures is to commit a patient to death. The hodgepog of therapeutic procedures inflicted upon patients with malignant melanoma should be eradicated. There is a treatment of choice for this disease, and it should become a standardized procedure in all hospitals where treatment of this malady is attempted.

Taking all factors into consideration, it would appear that the most expedient policy is to keep hands off all nevi that clinically appear quiescent and give no indication of malignant activity. Once any of the suspicious findings associated with malignant change have appeared, however, the immediate radical surgical removal of the local lesion is imperative. The same consideration should be accorded those nevi whose position subjects them to chronic irritation. If the histologic picture is compatible with malignant melanoma, the resection of regional lymph nodes is indicated in view of the experiences of Pack and Livingston who found involvement of clinically unsuspected nodes in 50 per cent of their routine resections. At the present time this regimen of therapy appears to offer the best chance of survival to individuals with and without malignant melanoma.

It is surprising to note how little has been made of the relationship between sexual maturity and poor prognosis as contrasted with sexual immaturity and good prognosis in patients with malignant melanoma. Fifteen patients of prepubescent age in the series of Pack et al.[10] have all survived indefinitely after treatment. These authors remark, "It must be accepted that this tumor has a most definite etiological relationship to hormonal factors originating in the pituitary, gonads, and adrenal cortex." Webster, Stevenson and Stout[12] call attention to the favorable prognosis afforded prepubertal children and cite the cases of two such children with malignant melanoma that are alive and well ten years after treatment. In addition to pointing out the discrepancy in the prognosis afforded children and adults with this disease Spitz[20] demonstrates histologic differences between juvenile and adult malignant melanoma.

Pack and Livingston[3] state they have never seen a malignant melanoma develop in a castrate male or female. This provides a marked contrast to the behavior of a malignant melanoma seen during pregnancy. Hamilton and co-workers[21–23] have shown that there is a profound effect exerted by the sex hormones, particularly the androgens, upon pigment metabolism.

In view of these observations and the hopelessness of the disease one would expect to note more than two reports referring to castration as a method of treating patients with malignant melanoma. Herbst[24] reported temporary favorable results in one patient while Howes[25] noticed no beneficial effect in another case in which this mode of therapy was used. Castration has been found to be beneficial in the treatment of patients with carcinoma of the prostate[26] and breast.[27,28] It would appear that the indications are not lacking to justify a more extensive clinical investigation of this mode of therapy for malignant melanoma even though experimental work on this problem has not been encouraging.[29]

SUMMARY

1. The clinical features of sixteen cases of cutaneous malignant melanoma have been presented. Only two patients are alive without disease four and a half years after treatment.

2. The present status of malignant melanoma is briefly reviewed.

3. A plea is made for early and adequate surgical treatment of this disease.

4. Attention is called to the paucity of reports on castration as a mode of treatment of malignant melanoma. It is pointed out that this procedure deserves further evaluation and trial.

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PERIANAL INFECTION IN THE TUBERCULOUS PATIENT

SURGICAL NOTES

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THERE is a definite field for anorectal surgery in a tuberculosis hospital. Complete and satisfactory eradication of local disease processes, including severe tuberculosis infection, is possible by means of proper surgical intervention. Therefore, in every case of phthisis the history should inquire into symptoms such as pain, swelling, bleeding and discharge referable to the anus and rectum. The physical examination should include inspection, palpation and proctoscopy of the terminal bowel. By this means, diseases affecting this portion of the bowel will not be overlooked.

This presentation is concerned with a study of 204 consecutive patients with anorectal complaints sufficiently severe to require treatment. They were examined in the Proctologic Clinic of the Berthold S. Pollak Hospital for Chest Diseases, a tuberculosis institution. In a previous paper this same series was the subject of analysis from a clinical point of view.[1] In this report emphasis will be placed on the surgical treatment of those anorectal conditions requiring this form of therapy. The decision for or against the ability of a patient with pulmonary tuberculosis to undergo such a treatment rests with the attending physician. The postoperative improvement in the patients' general well-being following the eradication of a serious perianal disease focus has been sufficiently encouraging that medical consent has been the rule. Exceptions have occurred under the following conditions: (1) the disease-active patient fails to respond to any form of therapy, (2) the chest condition has not been stabilized sufficiently and (3) complications, e.g., laryngeal or extensive intestinal tuberculosis, make the prognosis unfavorable.[2] It is the established rule that thoracic therapy has priority over anorectal surgery.

The lesions which occur in and about the rectum of tuberculous patients may be divided into two main groups, namely, those due to infection with the tubercle bacillus and those due to benign infections and other causes. In the last category may be mentioned mechanical injury by hard constipated feces or a chemical reaction to diarrheal stools; both conditions a frequent occurrence in the tuberculous patient.

BENIGN PERIANAL INFECTIONS

A summary of the proctologic findings in 204 patients is shown in Table 1. This table does not include the fistula infections due to the tubercle bacillus.

TABLE 1

Internal hemorrhoids	62
Fissure or ulcer	57*
Abscess	34*
Cryptitis and papillitis	42
Pilonidal sinus	3
External thrombotic pile	15
Pruritis ani	10
Total	223

* Of this number 11 and 19, respectively, were tuberculous.

It will be noted that the non-tuberculous disease conditions are the same as those which occur in a non-tuberculous individual. The relative frequency, in like manner, is the same with hemorrhoids, fissures, cryptitis and papillitis, the more common lesions present. In the majority of the patients under review more than one anorectal lesion was present at the initial examination.

In the selection of tuberculous patients for the surgical treatment of non-tuberculous anorectal lesions certain indications,

FIG. 1. In the prone jackknife position the patient is comfortably situated. Surgical technic is facilitated by good exposure; operator's movements free of the restraint imposed by the usual dorsosacral position.

as follows, are to be observed: (1) *eradicate an extra focus* of infection and thereby prevent systemic reactions such as fever and anorexia caused by it; (2) *eliminate local conditions* which are painful and debilitating; (3) *emergency measures* such as the incision and drainage of an acute abscess; (4) *prophylatic measures*, e.g., repeated crypt infection or pectinosis causing anal stenosis, also roseate of large prolapsing internal hemorrhoids; (5) *eliminate local causes of irritation and excoriation* as when caused by a chronic intractable pruritus ani with lichenification or low grade cellulitis; (6) *relieve digestive disturbances* caused reflexly by anorectal disease[3] and (7) *correct constipation* by removing an anorectal lesion which grossly interferes with bowel function.[4] The foregoing surgical indications may be properly divided into two categories, namely, active and elective surgery.

As a rule the first three indications should receive active surgical treatment. The postoperative reaction is minimal or absent and the beneficial results outweigh any possible detrimental effect on the patient. In considering the treatment of the remaining four or the elective group it should be remembered that the patient is suffering from a systemic disease of greater or lesser severity. This being the case, surgery may be postponed until the pneumonic lesion is stabilized and the general condition of the patient is improved. However, in the last analysis the judgment and experience of the proctologist is often the deciding factor. A number of prophylatic operations have been performed in this Clinic with decided benefit to the patient. In this benign group contamination of the postoperative wound with the tubercle bacillus has not occurred and the healing time has been satisfactory.

There are certain fundamental rules relative to operative procedures about the anorectal area which are applicable in all cases. They are as follows: (1) There must be *adequate exposure.* Low spinal anesthesia with 50 mg. of procaine is usually sufficient for complete relaxation and facilitates exposure of the entire operative field.

Pennington clamps should be properly placed about the anal margin in order to expose clearly the disease processes present for proper identification. (2) There should be *sharp scalpel dissection* (excision) of diseased tissues because, in contrast to thermal methods, it insures accuracy of dissection by clearly defining the diseased area and thereby obviates injury to normal tissues. The rule should be to remove "as much tissue as necessary and at the same time, conserve as much tissue as possible."[5] (3) A *surgical technic* should be employed which *will reduce the postoperative pain* and the time required for healing. *This is accomplished by reducing trauma and preventing wound infection.* The reduction of trauma may be brought about by the minimal use of clamps and sutures on healthy tissues, avoidance of mass ligatures, especially on muscles, and eliminating pre- and postoperative divulsion or stretching of sphincter muscles by digital or instrumental methods. Wound infection can be prevented by adequate external skin drainage, complete hemostasis and meticulous postoperative care of all wounds in order to obtain healing by second intention. With these precautions tuberculous patients generally respond satisfactorily to surgical intervention. A brief description of the operative technic employed in the more common of the non-tuberculous anorectal diseases

follows. As a rule all surgical procedures are performed with the patient in the prone jackknife position with the pelvis elevated on pillows and the buttocks separated with adhesive straps. (Fig. 1.) It is to be understood that the operative technic varies with the disease condition present and that each particular case requires the particular judgment of the operator; therefore, no hard and fast rules can be laid down for each case.

The postoperative management of wound healing in the following cases involve general principles to be discussed hereafter.

Hemorrhoidectomy

Objective. The ideal in a hemorrhoidectomy should be to control the blood supply and obliterate the venous (pile) mass with a minimum of trauma to normal tissues. This applies especially to the sphincter musculature and adjacent anatomic structures. Digital or instrumental dilation and massed ligatures should be avoided. This is best accomplished by an open method plastic surgical technic of the ligature-dissection-excision type of operation to be described hereafter. In this operation adequate exposure through sphincter relaxation is a necessity since it is then possible to visualize clearly what tissues are being manipulated and in which structures the sutures are placed. This is best accomplished by a low spinal or caudal anesthesia. The procedure outlined presupposes a knowledge of the anatomy of the anal canal including the blood and nerve supply. In planning the surgical approach *it is important not to disturb (e.g., by divulsion) the gross picture of the existing anatomic deformity in the anal canal in order to avoid confusion between normal and healthy tissues;* thereby less of normal tissue will be sacrificed and a better functional and cosmetic result will be obtained.

Operative Procedure. The everting Pennington clamps are applied to the four quadrants of the anal margin in such a manner as to expose the relation of the hemorrhoidal mass to each other and constantly keep under observation the entire lining membrane of the anal canal and rectum during the hemorrhoidectomy. (Fig. 2A.)

The most dependent hemorrhoidal mass is grasped at its outer extremity well out on the anal skin with an Allis clamp and drawn taut. (Fig. 2B.) A second Allis clamp is placed near the juncture of the hemorrhoid with the normal rectal mucous membrane. When properly placed these clamps delineate accurately the pile-bearing area as a spindle-shaped mass radial to the anal orifice. A plain linen or a No. 1 chromic catgut ligature on a small, round, curved needle is passed just above the pile mass through a sufficient thickness of normal rectal mucosa to surround all the blood vessels at the base of the hemorrhoid and tied firmly, thus securely shutting off the blood supply. An incision either with the scapel or scissors is made sufficiently deep in the outer extremity of the mass to expose the deep fascial plane and thereby obtain a line of cleavage in the pile-bearing area. From this point on the process is one of enucleation by stripping the pile mass down to a small pedicle. This is best accomplished with the aid of a strip of gauze aided occasionally by the separation with scissors of strands of the longitudinal muscle fibers which bind the pile mass down to the surrounding tissues. (Fig. 2C.) When properly performed the rounded belly of the external sphincter muscle is clearly exposed and inclusion of any of its fibers and nerve supply in the ligature avoided, thus obviating postoperative pain. The linen ligature is tied firmly over the normal mucous membrane at the base of the pile mass and the excess tissue excised leaving an adequate stump. When necessary the small vessels which escape the control ligature are closed with one or two interrupted catgut sutures. Other bleeding points are effectively controlled with artery clamps temporarily applied. The final result leaves a smooth external anal wound over which the skin margins readily approximate. (Fig. 2D.) For a few days free drainage is obtained until termi-

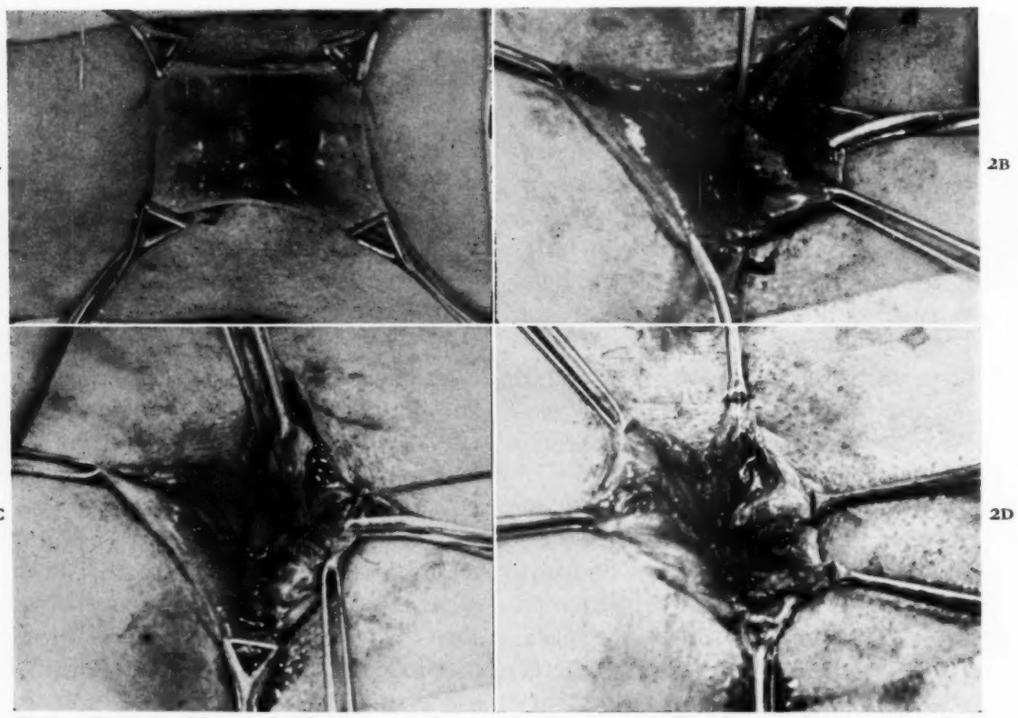


FIG. 2. Technic of hemorrhoidectomy. A, the everting, atraumatic Pennington clamps are applied to the four quadrants of the anal margin in order to expose the disease processes, including hemorrhoidal masses, for proper identification; B, delineation of pile-bearing area with Allis clamps; C, enucleation of pile-bearing area down to small pedicle and transfixion with linen suture ligature, fulfilling the criteria of avoidance of mass tissue ligature and permitting maximum wound drainage; D, the appearance of the anal canal after excision of all hemorrhoidal masses revealing clean-cut wounds draining freely.

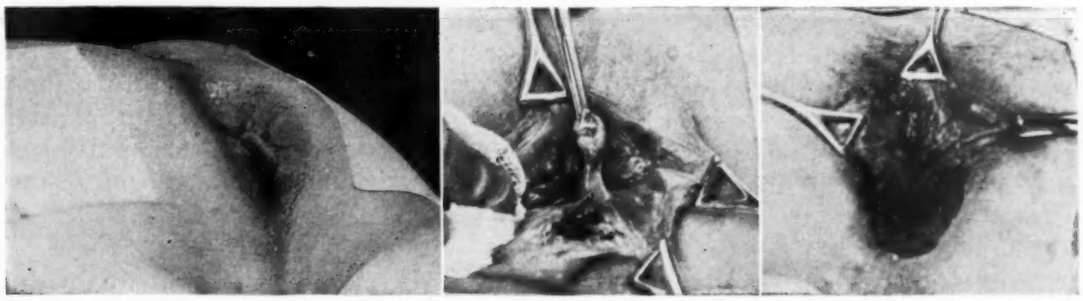
nated by the healing of the overlying skin. Each pile mass is individually excised, care being taken to leave sufficient skin and mucous membrane between adjacent raw surfaces. This technic answers certain criteria, namely, minimum trauma with maximum maintenance of tissue drainage and nutrition of tissues, complete hemostasis and minimal postoperative pain.

The foregoing procedure applies to pile-bearing areas arising from the three main branches of the superior hemorrhoidal veins. Frequently these are associated with dilated smaller vessels to form a roseate of varicosities around the circumference of the anal canal. The treatment consists of evacuation of the pile contents. This is accomplished by incising the mucosa over the more prominent pile mass and dissecting the dilated venules. Bleeding as a rule is minimal, however, if active approximation of the depth of the wound with a single figure eight catgut suture ligature is sufficient to produce hemostasis. This procedure eliminates the possibility of anal stenosis which may occur when total or mass extirpation of all the pile-bearing areas is performed.

Fissure-in-ano and Anal Ulcer

Objective. The operative treatment presupposes as its objective drainage of the involved infected area. It is not a question of the depth of the incision or of paralyzing the fibers of the sphincter ani by divulsion or other means as it is the application of the general principles of wound drainage. This is accomplished by excision of an inverted cone- or V-shaped section of anal skin and sharp division of the posterior fibers of the subcutaneous sphincter muscle. These principles apply to anterior anal ulcer or fissure.

Operative Procedure. The entire fissure-



3A 3B 3C

FIG. 3. Anal ulcer. A, reveals external "sentinel" pile of an anterior, chronic, tuberculous anal ulcer; B, exposure of anterior anal ulcer and internal "sentinel" pile; C, after excision of all diseased tissue leaving clean, smooth, well draining wound.

bearing area is grasped with an Allis clamp, or if an anal ulcer, it is applied to each margin. The entire disease-bearing area, including all fibrous tissue and sentinel pile, if present, is dissected *en masse*. (Fig. 3A and B.) The excision is carried posteriorly and the final wound has an inverted cone shape tapering toward the rectum and wide and well rounded toward the coccyx. The size of the external wound should be adequate, bearing in mind that healing occurs in the ratio of 3:1 in favor of the external wound. Drainage is improved by incising the superficial fibers of the subcutaneous external sphincter muscle posteriorly. The adjacent hemorrhoids if present are removed to prevent prolapse of it into the wound, and the edges of the rectal mucous membrane and anal skin are freshened to allow better drainage. If the rectal mucosa rolls upward, it is sutured to the external sphincter muscles with a few interrupted catgut sutures. This incidentally reduces the size of the wound and hastens healing. These are the essential features of fissure-ulcer surgery. (Fig. 3C.)

Perirectal Abscess

Objective. The treatment is adequate surgical drainage. (Fig. 4A.) An abscess cavity will granulate and heal in an inverse ratio to the size of the drainage wound. It must be designed to give the maximum of drainage with a minimum excision of normal tissue. This is obtained by incising the skin as widely as the widest part of the abscess. Where the abscess is associated with

4A 4B

FIG. 4. Evacuation of perirectal abscess. A, right ischiorectal, pyogenic abscess with secondary tuberculous involvement (Group III type); B, after incision and drainage along the longitudinal anteroposterior length of the abscess and close to the anal margin.

an internal opening the interposing sphincter fibers are incised at right angles and the tissues about the wound excised to improve drainage.

Operative Procedure. A preliminary puncture wound is made to release tension within the abscessed cavity. The wound is enlarged by a longitudinal anteroposterior incision throughout the length of the abscess and as near the anus as feasible. The depth of the abscess cavity is explored with the finger and pockets obliterated. The skin edges are excised to prevent overhanging flaps. The dèbridement of necrotic tissue, facilitated by the application of pure phenol solution into the wound, lessens toxemia and shortens the healing time. For the first twenty-four hours iodoform gauze is inserted into the wound and covered with a firm smooth supportive gauze dressing. The packing is not replaced. The resulting open wound can be properly medicated and granulates from the bottom up. (Fig. 4B.)

Pilonidal Sinus

Objective. The objectives are complete surgical extirpation during the *discharging* stage of all infected tissue in a chronic recurrent anococcygeal sinus and to attain an anatomic and clinical cure as determined by complete epithelization of the wound and the formation of a minimal firm, mobile, painless scar. These two criteria are to be based on the fundamental principles of wound healing described under the section Surgical Principles in Wound Management.

Operative Procedure (Open Method). The extent of the infected area in its superficial aspect is determined by careful finger palpation. The skin and subcutaneous fat outside the infected area is incised deeply by a semi-elliptical incision surrounding the sinus opening but not too near the anal orifice. The dissection is carried vertically down and just proximal to the sacral fascia, with any deviation necessary to include all pathologic tissue. Allis clamps are placed around the circumference of the diseased tissue and drawn upward sharply. This reveals the line of cleavage as represented by multiple strands of the fibers of the gluteus maximus muscle at its attachment to the presacral fascia. By careful blunt (scissors) dissection the infected mass is completely separated from its attachment to the fascia. It is highly essential to keep the level of the dissection as superficial as possible, consistent with complete extirpation of the infected tissue, so as to preserve intact the presacral fascia. Penetration of the posterior sacrococcygeal ligament, especially if some form of primary closure is attempted, frequently results in infection and recurrence.[6]

Satisfactory hemostasis is obtained with a minimum of sutures and ligatures and preferably by the temporary application of hemostats and oxycel[8] strips, the edges brought together with broad bands of adhesive strapping over which a firm pressure bandage is applied. The dressing is not removed for five to seven days, but the patient is ambulatory after the second day. Daily sitz baths in a solution of 1:8000 potassium permanganate is prescribed supplemented by systemic treatment (vide infra). The wound is frequently examined and cleansed, dead spaces and bridging avoided, and redressed after lightly sprinkling with sulfathiazole or sulfanilamide powder.

Pruritus Ani

Objective. The objectives are to drain infected subcutaneous perianal spaces (Fig. 5A), to remove anal hypertrophied folds in order to improve local hygiene, to regenerate new skin by removing hyperkeratonized or modified (avascular) skin and to cut the nerve pathway and disrupt the psychogenic factor in pruritus ani.

Surgical Procedure (Clover Leaf Operation).[7] Elliptical areas of involved skin are removed, the dissection extending out into the normal skin. (Fig. 5B.) The dissection is carried up but not into the anus. It is best to avoid any surgery in the anus or rectum except when a very important pathologic condition is present. Usually four to six areas are resected with ¼-inch wide band of skin between each ellipse. After the skin resections are removed, the intervening skin bands are undercut with blunt pointed scissors which are kept close to the skin. (Fig. 5C.) All nerve fibers are severed, *especially those entering the rectum at the dentate line.* The latter procedure is an essential part of the technic. Bleeding points are clamped or ligated and oxycel® strips are placed into the wound and under the skin flaps; thereafter a dry pressure dressing is applied. The dressing is changed in twenty four hours; the patient is ambulatory after the second day. Daily sitz baths in 1:8000 solution of potassium permanganate is prescribed following which the wounds are dressed with vitamin A and D ointment. Besides the usual care 3 per cent gentian violet is applied into the wound (rectum) at each office visit. Large doses (500 mg. daily) of vitamin C are prescribed in order to stimulate epithelization. When healing is complete, the perianal region is smooth and firm with a minimum of hair and sebaceous glands. (Fig. 5D.)

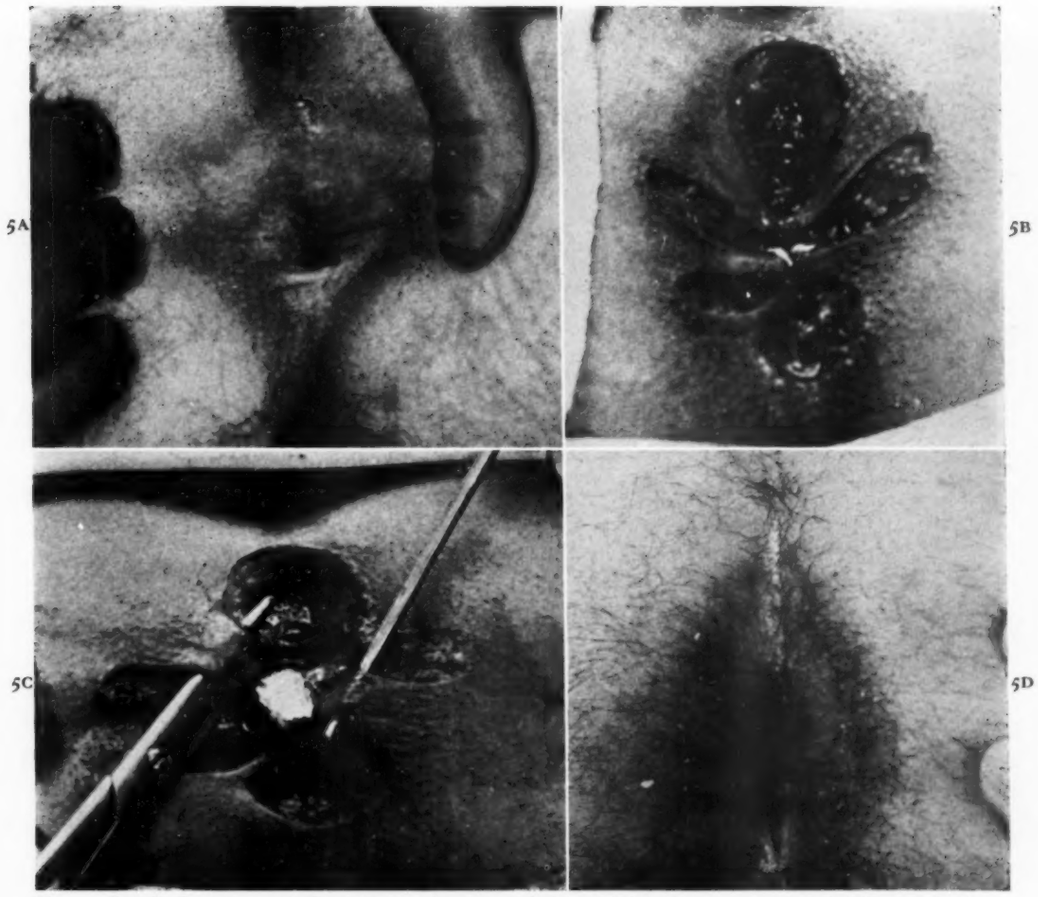
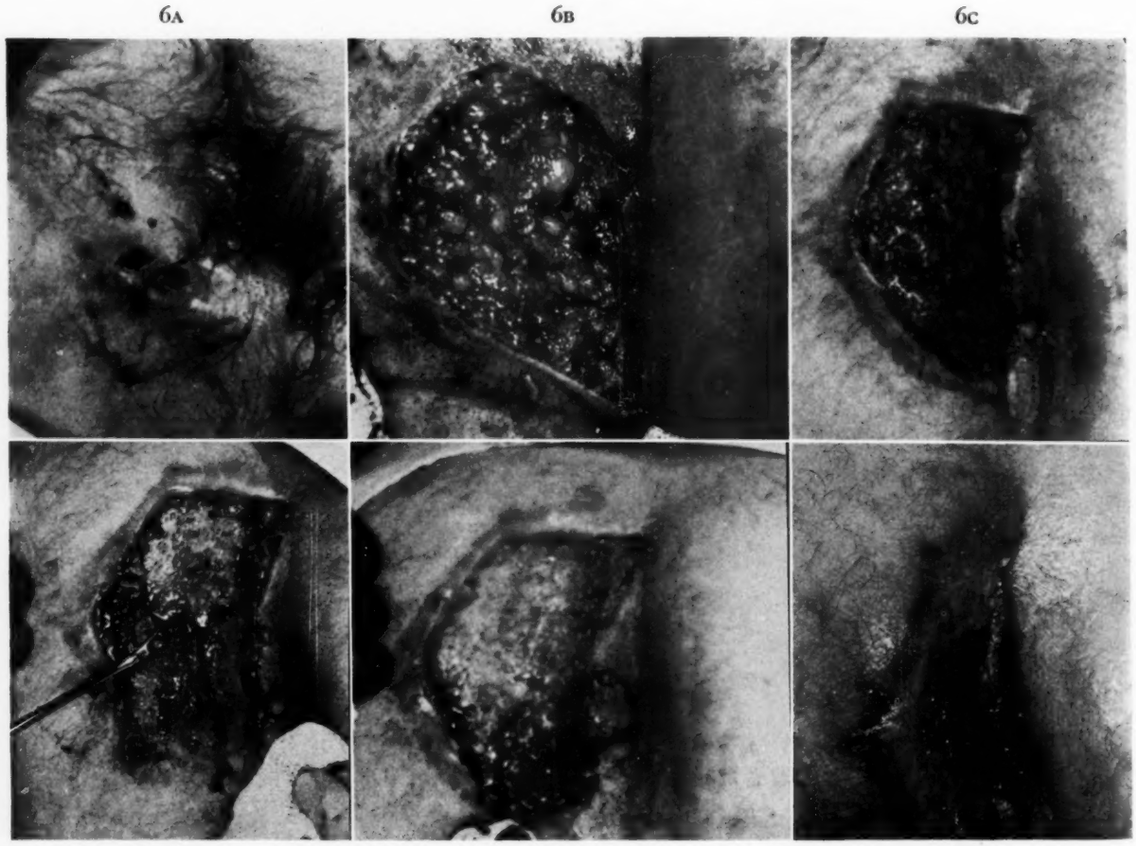


FIG. 5. Surgical treatment of pruritus ani. A, reveals loss of skin pigment and multiple excoriations, the site of predilection for infection; note edema due to vascular and lymph stasis due to low grade infection; B, elliptical areas of skin were excised (May 12, 1949) down to subcutaneous tissue thereby draining irritating chemical, bacterial and metabolic substances; the excision does not encroach on the modified anal skin (mucoderm) thus preventing anal stenosis; C, shows the intervening skin bands under cut, the blunt point of the scissor is carried well out under the anal skin, also internally to sever the sensory nerve fibers entering the rectum at the dentate line; D, appearance of perianal skin twenty-eight days postoperatively, showing complete healing except for small area anteriorly; complete relief of pruritic symptoms with normal sphincter control.

TUBERCULOUS PERIANAL INFECTIONS

Surgical principles in the treatment of anorectal tuberculosis are as follows: (1) Drain a perianal abscess as soon as it appears. (2) Radical excision of all diseased tuberculous tissue by sharp dissection with scalpel or scissors should be done to insure accuracy of eradication. (3) Multiple stage operations are indicated for extensive multiple lesions or where the internal opening lies above the internal sphincter muscle. In the latter case the principle of the seton is applied. (Fig. 9B.) (4) The value of multiple stage operations lies in that it will be better tolerated by the patient. It will prevent excessive anal distortion, insure good fibrous support and prevent incontinence. (5) It should be the rule to save uninvolved skin and subcutaneous fat in excising multiple lesions as these islands of normal tissue tend to maintain elasticity of the part and minimize distortion due to scar tissue contracture. (Fig. 8.) (6) Free drainage of all tuberculous infections is essential to insure healing. For this purpose wounds should be saucerized and prolonged packing avoided. Complete hemostasis is imperative. The absence of a cure of perianal tuberculosis



6A 6B 6C

6D 6E 6F

FIG. 6. Group 1. F. M., a male aged twenty-nine, with far advanced bilateral pulmonary tuberculosis. A, tuberculous perianal infection discharging seropurulent material through multiple external openings; local inflammatory reaction and pain minimal; B, April 7, 1949, the entire tuberculous infection was widely excised down to healthy subcutaneous fat and muscle including a small area of the surrounding healthy tissue; internal opening was absent; C, appearance of wound four weeks postoperatively; note exuberance of granulation tissue; D, long strips of granulation tissue are easily curetted with minimal pain and without the necessity of topical or systemic analgesia; occasionally nervous patients require mild sedation; E, after wound is curetted (bleeding is minimal) it is swabbed with 95 per cent phenol solution which is not neutralized with alcohol; the wound is then covered with a strip of vaseline packing and one or two strips of sterile gauze; heavy local dressings appear to retard wound healing; F, appearance of wound eight weeks postoperatively; complete healing occurred three weeks later with the formation of a firm but pliable scar without distortion of the anal canal.

is often due to failure to follow these principles.

The special group under consideration has the tubercle bacillus as the etiologic agent. It is characterized by the spontaneous formation of an abscess at the anal margin. The local inflammatory and systemic reactions caused by this organism are, as a rule, not severe. In the presence of superimposed infection with the pyogens, however, both reactions are marked. A typical tuberculous abscess if not incised ruptures painlessly and the discharge varies from seropurulent to a thin watery fluid. On the contrary, mixed infection results in a frankly purulent discharge. Because of these variations in the clinical picture but more particularly on account of the type of lesion produced by these organisms acting singly or in combination, perianal infection in the tuberculous patient may be subdivided into five distinct groups. These have been described elsewhere.[1] For the purpose of the present article a brief summary of three of these groups is herewith given, illustrated in each instance with the operative procedure necessary to cure the infection.

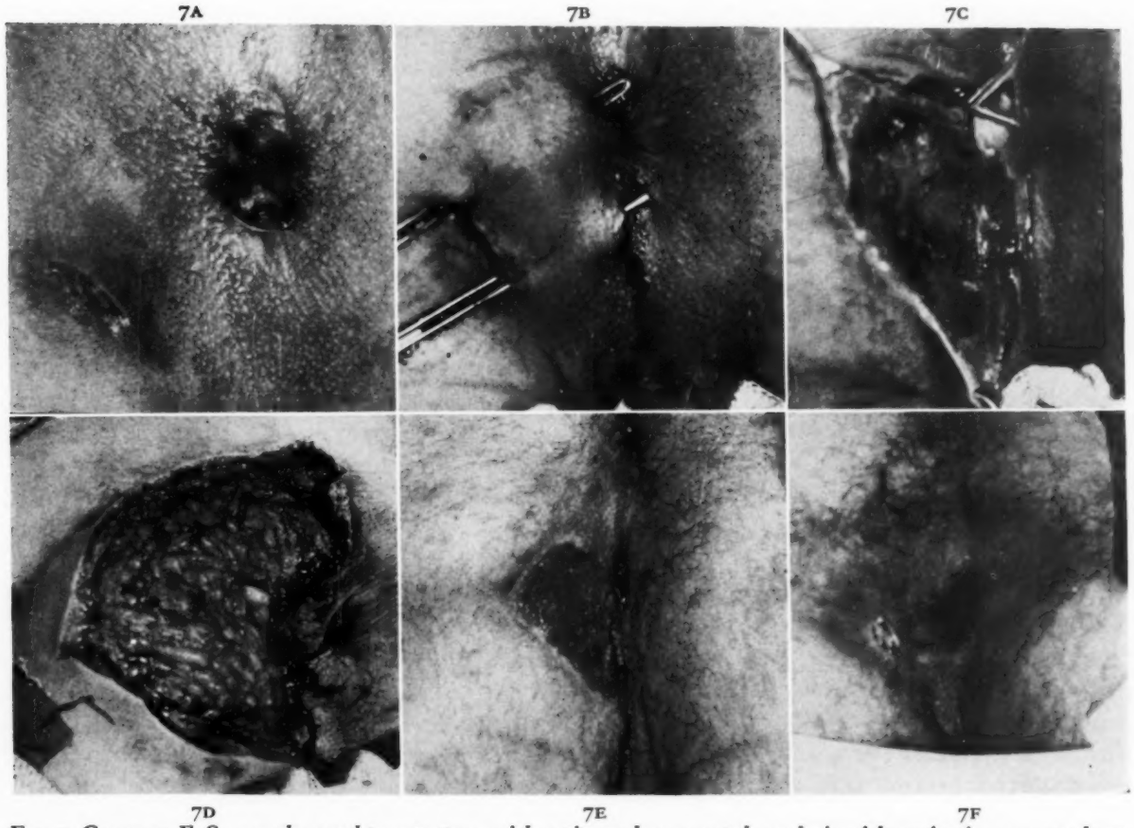


FIG. 7. Group II. F. S., a male, aged twenty-two, with active pulmonary tuberculosis with cavitation. A, note large ragged external orifice and brawny perianal induration; B, groove directors indicate the extensive perianal involvement; C, reveals definite cavity lined with the typical violaceous tuberculous granulation tissue; the infection extended into the rectum; D, all diseased tissue was excised March 17, 1949, including the area involving the rectum down to healthy fatty tissue and muscle; E, same patient, April 30, 1949, six weeks later, showing extent of healing with excellent sphincter control; the granulations were curetted and phenolized; F, eight weeks postoperatively. The perianal wound is healed except for very small area; the scar tissue is soft and pliable and there is no distortion of the anal canal.

Group I. Tuberculous Perianal Abscess: This appears as a superficial, subcutaneous, circumscribed swelling at the anal margin. There is very little inflammatory reaction or pain. If not incised the abscess ruptures usually through a pinpoint external opening. The discharge varies from a seropurulent material to a thin watery fluid. This group is the most frequent type of perianal tuberculous infection. A typical lesion is illustrated in Figure 6A.

The surgical procedure is as follows: A preliminary exploratory incision is made over the "abscess." This reveals the typical dusky, friable, tuberculous granulation tissue. A groove director is then inserted and the overlying skin incised in a crucial manner to the limit of the necrotic tissue. Several Allis clamps are applied at the margin of the wound and the entire lesion widely excised, including a small area of the surrounding healthy tissue and down to normal healthy subcutaneous fat or fascia. (Fig. 6B.) The extent of the tuberculous infection is not difficult to recognize because of the characteristic cyanotic or violaceous color of the diseased tissue (granulations). This type of infection rarely has an internal opening and, therefore, exploration for it is usually without result. Healing occurs with proper postoperative care. (Fig. 6C, D, E and F.)

Group II. Primary Tuberculous Infection with Secondary Pyogenic Involvement:

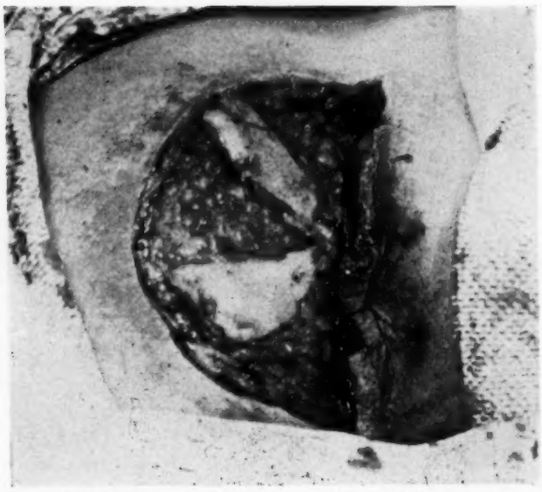


FIG. 8. Illustrates the preservation of islands of uninvolved skin and subcutaneous fat in extensive tuberculous infection thereby minimizing distortion due to scar tissue contracture.

This group is characterized by the formation of a painful, tender, brawny induration at the anal margin. If not incised the abscess ruptures and discharges a frankly purulent material for a brief period. In a few days this becomes scanty and seropurulent. Examination reveals a widespread infection and a rather large, ragged external orifice which when enlarged reveals a definite cavity lined with the typical violaceous tuberculous granulation tissue. (Fig. 7A, B and C.) This group may reveal an internal opening.

Surgically, a groove director is inserted into the opening of the well defined cavity and the tissues over it incised. This will reveal little or no purulent material but a cavity lined with the typical dusky or violaceous friable granulation tissue. (Fig. 7C.) The entire lesion is carefully dissected, the diseased tissue being easily identified. The resulting wound should be "saucer shaped," the base consisting of normal healthy fat or fascia. (Fig. 7D.) Healing is shown in Figure 7E and F.

The internal opening if present is simultaneously excised. However, if it lies above the internal sphincter muscle, a black silk thread (seton) is passed through the remaining fistula and tied so as to encircle the sphincter muscles. (Fig. 9B.) This simplifies the identification of the remaining tract at the time of the secondary operation. The primary wound heals by granulation so that finally a wide, gaping perianal wound is replaced by a block of firm fibrous scar tissue adherent in the anal portion to the lateral borders of the sphincter muscle. When this has occurred, using the seton as a lead and under local 1 per cent novocain infiltration a groove director is passed through the remaining tract and the overlying tissue incised. The edges of the wound are excised, leaving a clean "gutter-shaped" wound. Wide retraction of the severed ends of the sphincter muscle is prevented by adhesions of the muscle to the block of scar tissue at the site of the primary operation. By using this two-stage method, sphincter function is preserved and incontinence prevented.

There are certain cases in Group II which are of particular importance because of the multiple extension of the tuberculous infection. In these cases when the tuberculous granulation is explored with a probe, it will be found to comprise the lumen of a sinus or fistula connecting adjacent "abscesses." Under these circumstances a probe is threaded through the tract and the underlying infection exposed by incising over it. All diseased tissue is then excised, being careful to leave islands of uninvolved skin or tissue if possible. (Fig. 8.) If the resulting wound promises to be extensive, eradication of the entire diseased area is deferred for several weeks to allow healing of the primary wound in order to insure fibrous support to the perianal tissues by the formation of a block of scar tissues.

Group III. Pyogenic Perianal Infection with Secondary Tuberculous Involvement: This variety begins as a frankly pyogenic abscess. There is the rapid formation of an intensely tender, fluctuating mass associated with severe pain and a rise of temperature to 103° to 104°F. Incision and drainage evacuates a foul, frankly purulent material typical of a pyogenic infection. Since the deeper perirectal spaces are involved (usually ischio-anal) the cavity is larger and

FIG. 9. Group III. M. M., a male aged fifty-two, with bilateral active pulmonary tuberculosis. A, external opening of tuberculous infection of the postanal space with extensive invasion of adjacent tissues; B, principle of the seton. All diseased tissue has been excised down to anal fascia. The internal opening was above the internal sphincter muscle. Linen thread (seton) encircles the sphincter muscles. After primary wound is replaced by block of scar tissue, remaining tract is incised under local anesthesia. Adherence of severed muscle ends to scar preserves sphincter function and prevents incontinence; C, demonstrates wound eight weeks postoperatively and artery clamp in remaining portion of fistula tract; the illustration does not adequately reveal the true thickness of the intervening tissue and sphincter muscle; D, the three divisions of the external sphincter muscle have been severed leaving the puborectalis and longitudinal muscles intact as additional support to sphincter function.

deeper than in the group previously described. (Fig. 9A.) The presence of the typical tuberculous granulations lining the cavity reveals the true nature of the infection. This type may occasionally contract down to a fibrous mass and simulate the ordinary pyogenic fistula. Also, it may reveal an internal opening in contrast to the first two groups which are usually sinuses.

In the main the operative procedure is similar to that described for Group II. However, should this type contract down to simulate a pyogenic fistula, the tract is incised over a groove director or probe. If the internal opening can be located, the excision should begin there and carried outward to the external opening. The overhanging wound edges are excised (with due regard to save as much healthy skin as possible) in order to obtain proper drainage. The tuberculous granulations are curetted with a bone curet and the wound proper swabbed with pure phenol and not neutralized with alcohol. Iodoform strips are packed into the wound and removed in twenty-four to forty-eight hours. Afterward the wound is left open. (Fig. 9B to E.)

For satisfactory results in all operations for tuberculous fistulas certain rules must be observed. If there is a nodule of scar tissue or if the inflammation extends into the rectum, the excision should be carried (extended) into the rectum to include all diseased tissue. Chronically inflamed tissue at the upper extremity of a fistulectomy wound will delay or more often prevent

FIG. 9. E, forty days postoperatively showing wound healed; sphincter control normal.

healing if such a diseased tissue is overlooked. Surgery for tuberculous perianal infection should be radical, a wide-open wound which drains readily is essential to insure complete healing.

It is important to emphasize that the aftercare of those patients with tuberculous fistula is somewhat different from that of non-tuberculous individuals. It demands much patience and the time of the physician. It is essential that the wound be kept wide open at all times and compelled to heal by granulations for if the edges come together, further fistulous or sinus tracts are prone to develop. Hot sitz baths twice daily to all but bed patients hastens the process of repair.

The exuberant granulations are removed once or twice weekly with a sharp uterine or bone curet and the wound swabbed with pure phenol, followed with a strip of vaseline packing to prevent destruction by adherence of the gauze dressing to new granulations with each subsequent dressing. Where the healing is sluggish an ointment containing vitamins A and D appears to stimulate epithelization.

A frequent cause of delayed healing is reinfection of the wound with the tubercle bacilli since the rectum (stool) frequently contains viable virulent organisms. The application of pure phenol after curettage reduces this possibility as well as the size of the wound. If the primary excision has been complete, wounds have healed even in patients with far advanced pulmonary involvement and high concentration of bacilli in the sputum.

Surgical Results and Rate of Healing

As a general rule surgical wounds heal more slowly in the tuberculous patient than in the non-tuberculous individual. This applies to both the specific and benign group. Added to this is the factor of delay in instituting therapy for the anorectal disease caused by various diagnostic and therapeutic procedures carried out for the pulmonic infection; therefore, the evaluation of the surgical results and rate of healing is difficult. A critical analysis of this phase of the subject will form the material for a future article; therefore, only general statements are presented here.

In the benign group all of the patients subjected to surgery healed without undue difficulties. In this connection it should be stressed that adequate drainage of all postoperative wounds reduces the possibility of secondary infections by tubercle bacilli. It is of greater importance in healing than the factors of the extent of pulmonary involvement or sputum status; the majority of these patients had far advanced lesions with positive sputum.

The average time of healing in the tuberculous group was four months; a number healed before and a few after this period. The shortest time was three weeks and the longest fourteen months. Usually new foci of infection with the tubercle bacillus prolonged a cure. Another frequent cause of delayed wound healing was due to the remarkable tendency in tuberculous patients for overgrowth of granulation tissue. This also applies to the benign group and it recurred in spite of frequent curettement and phenolization of the wound. Sometimes multiple stage operations explain the prolonged healing time. In the final analysis if the operation has been adequately per-

formed, complete eradication and cure of the specific lesion can be anticipated.

The postoperative reaction in the entire series of patients subjected to surgery was not marked at any time. A few individuals had increased fever or the occurrence of fever although previously afebrile. Increased pulmonary involvement or evidence of an unfavorable reaction for periods of from a few days to several weeks was observed. Even in this group the permanent results have been good. The fact that the patient is usually made more comfortable by the removal of a source of toxemia or pain should commend this type of surgery to a proctologist.

SURGICAL PRINCIPLES IN WOUND MANAGEMENT

As proctologists we are interested in the treatment of wounds in and about the anorectal area produced by surgical procedures in the eradication of gross lesions and the treatment of infection. Tissue repair of a wound is a complex biologic process which can be aided by proper postoperative care or retarded by poor management. To understand some of the problems involved it will be necessary to review briefly the physiology of tissue repair and to enumerate certain fundamental principles in proctologic surgical technic conducive to wound healing. It seems appropriate to include this subject in a surgical paper since a knowledge of postoperative wound management is a cardinal tenet of all operative procedures.

In presenting this subject of wound management we have obtained valuable assistance from articles previously contributed by Berry,[8] Co Tui[9] and others.[10,11] These authors have contributed valuable material to the principles involved in wound healing of surgically treated patients.

We wish to discuss the subject from the standpoint of the proctologists, with due consideration for the differences in surgical approach applicable to anorectal disease processes. For example, one of the chief characteristics of terminal bowel surgery is that all operative procedures performed for the relief of a disease condition must provide adequate external drainage in every case. For this purpose all wounds which originate in the rectum or anal canal should extend out onto the skin surface. This rule, except in traumatic wounds, is not as universally applicable to general surgery.

In most instances granulation tissue is essential to the healing of wounds. Grossly, the manner in which this occurs is usually divided into three categories (Christopher[11]). When the wound edges are accurately approximated by granulation tissue, healing is by *first intention;* if the wound edges are widely separated and the epithelization occurs on the surface of the wound, healing is by *second intention;* when the edges of a gaping wound are approximated (e.g., by sutures) and the granulating tissue grows in between the approximated surface, healing is by *third intention.* The importance of this brief recapitulation of wound repair lies in the fact that in general healing by second intention is intentional and desirable in proctologic surgery.

A more detailed description of wound healing may be briefly described as follows: The physiologic process of wound repair is normally brought about by the proliferation of the epithelial cells. In the process the cells themselves liberate an enzyme called by Menkin[12] leukotaxine, which causes vasodilation, congestion, increased capillary permeability and extravasation of serum. This exudate is in response to an inflammatory reaction incident to surgical trauma (or infection) and contains leukocytic enzymes and macrophages which cleanse the wound of necrotic cellular débris and other foreign bodies. This in turn aids the formation of fibrous tissue. This is a fundamental phase of wound repair and is often prolonged in the presence of infection, foreign bodies (sutures), devitalized tissue and impaired circulation.

To minimize or obviate these retarding influences to wound healing, there are certain factors under the control of the surgeon which provide optimum conditions

for wound healing. These conditions may be divided into local and systemic factors.

The *local factors* are: (1) careful handling of tissues during operative procedures in order to prevent excessive or unnecessary damage to tissues in or about the wound; (2) the avoidance of mass ligatures, thereby insuring the integrity of the blood and lymphatic supply to the part and (3) eliminating large or prolonged gauze drains in postoperative wounds since they interfere with drainage, act as foreign bodies and are conducive to infection of the wound. Other factors of prime importance in the prevention of local tissue infection are: sharp dissection with a knife since it is least damaging to living tissues and provides the optimum wound for healing; adequate drainage of wounds about the anorectum in order to prevent local vascular stasis and lymphedema; excision of all diseased tissue to insure a healthy wound and to prevent delayed healing; complete hemostasis since blood is a good culture media and, also, hemorrhage in a wound separates living tissue and increases the amount of work living cells must do to bridge the defect; and minimal sutures, ligatures and ties as these act as foreign bodies and are conducive to infection.

The *systemic factors* that improve wound healing relate to the general nutritional state, particularly as it concerns protein metabolism, avitaminosis, especially of the water-soluable vitamins C, A and D, and the blood picture.

The role of protein nutrition in tissue repair is now well established.[9,10] A deficiency of protein storage in the body, either from a nutritionally poor diet or increased metabolic loss of nitrogen as a result of injury or disease seriously retards wound healing by interfering with fibroplasia. On the other hand, an excess of protein intake in the form of intravenous hydrolysate and amino acids will accelerate wound healing in surgically treated patients. Such treatment, however, is required only in exceptional cases after proctologic surgery. Early postoperative feedings with a high protein diet as contained in liberal portions of meat twice daily supplemented by oral ingestion of a protein hydrolysate is usually sufficient to overcome protein deficiency, maintain tissue integrity and aid wound healing.

The biologic factors which influence wound healing concern especially the water-soluble vitamins A, D and C, of which the latter is the most important. Many people on ordinary diets show some degree of deficiency of these and the other vitamins of the B complex group. Of these the vitamin C factor plays an important role in the repair of wounds since it is an important stimulant to epithelization and granulation of wounds. A deficiency in this vitamin also interferes with the formation of intracellular cement substances. The administration of 500 mg. or more of vitamin C daily in addition to therapeutic doses of vitamin B complex should be a routine postoperative procedure.

The third general factor which retards wound healing is the presence of secondary anemia. Anorectal wounds heal poorly or slowly in the presence of even a mild degree of anemia. This condition is a common finding in patients with anorectal disease even in the absence of a history of rectal bleeding. A red blood cell count of 3,500,000 and a hemoglobin of 65 per cent is a frequent preoperative laboratory report (unpublished data). The treatment of anemia in connection with the aforementioned systemic factors require attention in the postoperative management of rectal wounds; and since, usually, it is of the hypochromic microcytic type, some form of iron is indicated such as feosol® or ferrous gluconate,® two tablets post cibum. These are not constipating and, in fact, have a mildly laxative effect.

SUMMARY AND CONCLUSION

There is a definite field for anorectal surgery in the tuberculous patient. Complete and satisfactory eradication of local disease processes including tuberculous infection is possible by means of proper surgical technic.

The subject matter has been presented in three parts: The first part concerns benign lesions. These are in no way different from similar conditions in non-tuberculous individuals. The indications for surgery are enumerated and the operative methods are discussed. The objective in a hemorrhoidectomy is the obliteration of the pile mass by a ligature-dissection-excision technic with minimal trauma of normal tissues and adequate external drainage. Fissurectomy entails excision (dissection) of all diseased tissue and sufficient adjacent skin to insure proper healing from within out. This is frequently facilitated by incising the superficial fibers of the subcutaneous external sphincter muscle. All abscesses about the anorectum should be incised and drained early. This is accomplished by a longitudinal anteroposterior incision as wide as the widest part of the abscess. When an internal opening is present, it should be eliminated at the same time. The objective in the surgical treatment of pilonidal sinus is the complete extirpation during the discharging stage of all infected tissue and the formation of a well healed, mobile, painless scar. The surgical treatment of chronic intractable pruritus ani is predicated upon drainage of infected perianal spaces by excising several segments of hypertrophied folds of diseased skin followed by regeneration of a firm, smooth epidermis free of hair and secreting glands. The severence of the subcutaneous sensory nerve pathways, thereby eliminating the psychogenic factor in pruritus ani, is an important part of the treatment.

The second part concerns the surgical treatment of perianal tuberculous infection. The principles enumerated consist of the radical (scalpel) excision of all diseased tissue; multiple stage operations for extensive infection with preservation of islands of normal tissue to insure elasticity of the part and minimize scar tissue contracture. The operative procedure involved in the eradication of the three more common forms of the disease has been described. All postoperative surgical wounds should be saucerized, should drain freely and heal by second intention.

The rate of healing in benign and specific infections in the tuberculous patient is retarded but the results are uniformly satisfactory. Some of the causes of delay in wound healing are due to reinfection of the wound or new areas of normal tissue with the tubercle bacilli, excessive overgrowth of granulation tissue in the postoperative wound, and lack of recuperative powers in a patient with a depleting systemic disease. The postoperative reaction is, as a rule, absent or minimal and only occasionally is the pulmonary process adversely affected.

In regard to the third part, the result of surgical treatment in rectal lesions in the tuberculous patient depends largely upon the technic employed and the care which the patient receives postoperatively. Because of a better understanding of these two factors it is now possible to subject a higher percentage of these patients to surgery than formerly. The general care of the patient is of equal importance with the surgical technic—a fact not sufficiently stressed.

The basic discoveries of the investigative surgeons (Clark, Howes and Ravdin[13]) have contributed to an understanding of the complex biologic process of tissue repair. These apply particularly to the beneficial effects of protein as well as vitamins of the B complex group on the healing of surgical wounds. Treatment, including the administration of iron when indicated, has been discussed. The observance of certain important principles of atraumatic surgical technic as an aid to wound healing has been outlined. These concern care in the handling of tissues, the maintenance of the integrity of the blood supply, the prevention of local tissue infection and adequate drainage of all surgical wounds about the anorectum. To these may be added early postoperative ambulation of the patient.

If any conclusions are to be drawn from what has been stated it is that the science (principles) of surgery cannot be disestablished from the art (skill) of surgery. In

order to obtain a satisfactory operative result the two are inseparable and must be combined. This dictum applies also to proctologic surgery.

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Many cases of malignancy of the nasopharynx are skipped because it is often difficult to diagnose them correctly. Most of the cases arise from the mucosa of Rosenmueller's fossa. Metastases occur to the cranium in about one-quarter of all advanced cases but the cervical nodes are usually involved first. The patient's initial symptom is swelling in size of neck or pain on the side of head and face. The sixth cranial nerve shows clinical involvement in almost a third of all patients; many have Horner's syndrome. Many of these patients die within one or two years because the cases are not quickly diagnosed and because our therapy is not always followed by the successful results we anticipate. Treatment is by radiation alone; surgery is limited to biopsies. (*Richard A. Leonardo, M.D.*)

Streamlined Articles

ORTHOPEDIC SURGERY ON PARAPLEGIC PATIENTS*

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ORTHOPEDIC surgery on paraplegic patients can be undertaken with safety. It has been used on paraplegics to improve gait and stability, to eliminate the need of an orthopedic appliance or to better a difficult nursing problem. In addition, orthopedic surgery can be a valuable asset in the treatment of Pott's paraplegia. A review of twenty-one orthopedic procedures on fourteen paraplegic patients is presented.

* * * *

During this past decade remarkable advances have been made in the care and treatment of paraplegic patients. The literature contains many reports concerning the surgical, neurosurgical and urologic aspects of therapy, as well as the eventual rehabilitation of the patient. Very little, however, has been written about the orthopedic managment of these patients despite the fact that reconstructive surgery plays a very important role in the late treatment of paraplegics.

It is the purpose of this report to show that a variety of rational orthopedic procedures is beneficial to the rehabilitation of paraplegic patients.

From March, 1947, through November, 1948, 137 patients with paraplegia were admitted to the Staten Island (Halloran) Veterans Administration Hospital. During this period fourteen orthopedic operations were performed upon ten paraplegics who had spinal cord injuries and who revealed all degrees of motor and sensory loss. Their lesions varied from a complete transection of the spinal cord to a partial and minimal destruction of cord elements.

Besides the ten traumatic paraplegic patients who had surgery, four additional patients with paraplegia below the level of an associated tuberculous lesion of the spine were submitted to seven spine fusions.

In our experience surgery on paraplegics is no more hazardous than on any other group of patients of similar ages. Successful and beneficial surgery has been done on one patient over sixty years of age.

If postoperative plaster of paris cylinders and splints are used, they must be carefully and thoroughly padded so that atrophic, inelastic skin with poor or absent sensory supply will be protected. Obviously, consideration must be given to the patient's general condition with regard to his nutrition, hemic component, nitrogen balance, etc. Adequate nursing care, particularly on the patient subjected to spine surgery, can be obtained by placing him on a Stryker frame. Throughout the orthopedic management of the patient there must be no abatement of his care generally; certainly his bladder status must be closely supervised by a urologist.

All of our patients received general anesthesia. Pentothal, cyclopropane, nitrous oxide and ether were used either singly or in various combinations with one another. Despite the fact that several patients had complete anesthesia at the site of surgery, they were given general anesthesia in order

* From the Orthopedic Service, Staten Island (Halloran) Veterans Administration Hospital, Staten Island, N. Y. Published with the permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the author.

to effect more complete relaxation of their limbs.

The patients were fairly comfortable during their immediate postoperative and convalescent periods. In sixteen surgical procedures no postoperative morbidity whatsoever existed. Three additional patients were afebrile after the fourth postoperative day.

TABLE I*

Type of Operation	No. of Patients	No. of Operations	Wound Infections	Deaths	Results
Arthrodesis of subtalar joint	4	4	0	0	Fusions obtained; all patients improved
Arthrodesis of ankle joint	1†	1	0	0	Fusion obtained; patient improved
Arthrodesis of spine	1	1	0	0	Fusion unsuccessful; slight increase of back stability
Repair of clawfeet	1	2	0	0	Objectively improved
Nailing of fractured hip	1	2	0	0	Fracture healed; patient improved
Section of obturator nerve	3	4	1	0	One patient much improved; two patients unimproved

* Data on ten traumatic paraplegic patients who were submitted to fourteen orthopedic procedures.
† This patient is one of four who had a subtalar arthrodesis.

One patient had an infrapubic obturator nerve section in the face of a suprapubic cystotomy with an indwelling catheter and one of the two wound infections in our series developed in this patient. He became afebrile on the tenth postoperative day.

One patient with tuberculosis of the cervical spine had a fever fluctuating between 101°F. and 102°F. for at least twenty-one days prior to surgery. Following a spine fusion his fever rose to 102.4°F. but it dropped to its preoperative level in five days. This case was the only one in our group which had a fatal outcome. The man's death two and a half months after surgery resulted from tuberculous meningitis proven by necropsy.

There were two low grade wound infections both of which were caused by hemolytic staphylococcus aureus, coagulase negative. (Tables I and II.)

While it is much too early to evaluate accurately the results of orthopedic surgery in this group of paraplegics, we can say that it was generally beneficial and several patients had remarkably good results. The affects of surgery will be summarized briefly with typical case reports.

TABLE II*

Patient	No. of Operations	Wound Infections	Results
S. F.	1	0	Complete return of motor and sensory function
P. M.	3	1	Complete return of motor and sensory function
R. S.	2	0	Very slight return of motor and sensory function
H. W.	1	0	Gradual, slight return of motor and sensory function; died two and one-half months after surgery of tuberculous meningitis

* Data on four paraplegic patients with tuberculosis of the spine who were submitted to seven spine fusions.

CONDITIONS TREATED

Arthrodesis of the Subtalar Joint. Each of four patients was submitted to subtalar arthrodeses in order to improve stability in standing and walking and to eliminate drop-foot braces. One of these patients also had a fusion of an ankle at a separate operation. The convalescence of all of these patients was smooth and successful arthrodeses resulted in every case.

CASE 1. G. K., a thirty-three year old white male, was wounded in the low back in April, 1945, and he sustained an incomplete section of the cord at the level of L4. He had a completely flail left ankle as well as spastic paralysis of the right lower extremity.

On March 11, 1947, a subtalar arthrodesis of the left foot was performed and his limb was immobilized for twelve weeks in a plaster boot which extended from below the knees to the toes. The subtalar joint was fused by the time the plaster was removed. On January 8, 1948, his left ankle was arthrodesed and the limb was placed in a plaster cylinder which extended from the mid-thigh to the toes. At the end

of a twelve-week period of immobilization the ankle was solidly fused.

The patient's gait is now much improved and it is no longer necessary for him to wear a dropfoot brace on this leg.

Arthrodesis of the Spine. One patient had an arthrodesis of the spine to repair a laminectomy defect. Although a fusion was not obtained, the increased stability resulting from the operation has been beneficial to the patient.

Case II. D. S., a thirty-five year old white male, was injured in September, 1944, by a shell explosion causing a cord lesion at the level of L1, 2 and 3. A laminectomy from L1 to L3 was done on the day of injury. One year later the patient began to regain bladder and bowel control as well as a marked degree of control of both thigh and left leg musculature which had previously been paralyzed. On admission to this hospital he complained of pain and instability in his back in the region of the laminectomy.

On June 24, 1947, a spine fusion was done extending from D12 to L4, using a long cortical clothespin-type graft from the right tibia together with iliac bone chips. The patient was then placed in a removable bivalved body plaster case for ten months after which time he began to wear a heavy lumbosacral corset. His right leg was placed in a plaster cylinder from high thigh to toes and this was cut down to below the knee after five months. After three more months he was fitted with a leg brace with a supporting leather cuff and he began weight-bearing with the help of a cane.

Sixteen months postoperatively this man was walking with improved stability but he continued to complain of back pain. X-rays revealed a pseudarthrosis between the distal portion of the tibial graft and the spinal laminas. The proximal end of the graft appeared to be fused to the spine.

The patient will undergo another operation in order to repair the pseudarthrosis.

Repair of Clawfoot by Tendon Transplants. One patient had bilateral clawfeet with hammer toe deformities and two reconstructive operations were done, one upon each foot, with objective improvement.

Case III. R. M., a twenty-five year old white male, suffered a compression fracture of the bodies of L1 and L4 in December, 1944. He had initial paraplegia but gradually regained lower extremity strength and sensation. His residual damage consisted of diminished spotty sensation with clawfoot and hammer toe deformities of both lower extremities. His toes were painful and frequently became ulcerated as a result of the deformities.

On April 2, 1947, the long extensor tendons of the toes of the left foot were transplated proximally and all of the interphalangeal joints were arthrodesed. A plaster boot immobilized the foot for six weeks. On May 14, 1947, a similar procedure was done on his right foot and toes.

When the patient was reexamined eighteen months later, the clawfeet were corrected and the patient was able to walk. Cosmetically, the result was good. However, the patient reported progressive and increasingly severe attacks of muscle spasms affecting both lower extremities. These spasms have been giving him more and more difficulty and prevent him from walking for any length of time. Nevertheless, his foot hygiene did improve following the operations and pain and ulceration of his toes have diminished.

Nail Fixation for Pertrochanteric Fracture. One paraplegic patient fell and fractured his right hip. Internal fixation with a three-flanged nail was followed by bony union of the fracture three and one-half months later when weight-bearing was resumed.

Case IV. J. G., a twenty-three year old white male, received a crush injury with resultant paraplegia at the level of D12, L1. He suffered loss of sensation and motor power distal to both upper thighs but he was able to ambulate with crutches and two long leg braces.

On May 27, 1948, while getting into an automobile, he fell and fractured his right hip. X-rays revealed a pertrochanteric fracture with no displacement. On the same day a nail was inserted across the fracture site and the patient was placed in Russell's traction. Because of the unsatisfactory position of the nail it was removed on June 8, 1948, and reinserted properly. The patient was replaced in traction (5 pounds) for nine days. On September 28, 1948, x-rays revealed good bony union and weight-bearing with long leg braces and

crutches was instituted. This patient has since resumed all of his preoperative activities.

Section of the Obturator Nerve. These procedures were performed four times on three patients, all of whom had marked adductor muscle spasm. The operation was done upon two patients primarily to relieve a bad nursing problem. The other patient was able to walk again with the help of crutches and braces following surgery.

With the exception of the case to be reported the results of this operation were disappointing. In the following case, besides sectioning the obturator nerve, the adductor muscles were extensively cut at their origin until the deformity could be overcorrected on the operating table. Our results indicate that cutting the tight adductor musculature is more effective than sectioning the nerve in relieving this deformity.

CASE V. J. K., a twenty-three year old white male, sustained a bullet wound of the bodies of L1 and L2 in September, 1944. Marked spasticity of the left gluteal musculature developed, with resulting upward dislocation of the left hip joint. Two hip fusions had been attempted elsewhere and had failed. In spite of this he was able to walk with the aid of long leg braces and crutches.

He entered this hospital on April 10, 1948, because of pain in the left hip of three days' duration after twisting this joint. On admission he had a flexion deformity of 35 degrees and an adduction deformity of 60 degrees with spasm of the thigh adductor muscles.

On June 25, 1948, by way of an intrapelvic approach, the left obturator nerve was cut. Through the same incision the adductor musculature was sectioned at its origin until the hip could be abducted to 60 degrees. Pillows and traction were used to maintain the abduction of the thigh. After three weeks the patient was encouraged to ambulate. Five months later this patient demonstrated a better gait than at any time since his injury and he stated that he had improved stability. The left hip could be abducted to 25 degrees and no flexion deformity of this joint existed.

Tuberculosis of the Spine. In four patients with tuberculosis of the spine paralysis developed in a rather short time with resulting paraplegia distal to the level of the destructive lesion. Arthrodesis of the spine was done to put the involved spinal segments to rest.

Destruction of spinal cord tissue is an irreversible process; but when tuberculous granulation tissue about the cord causes paraplegia from compression, complete immobilization of the part permits resorption of this infectious granulation tissue with a resulting mitigation of paralysis. Arthrodesis is designed to effect complete immobilization.

Seven spine fusions were done on the four patients in this group. Two patients displayed remarkable recoveries following surgery. One patient has had very little improvement and the fourth man accounted for the only death in our series when he died two and one-half months after surgery as a result of tuberculous meningitis.

CASE VI. P. M. was a thirty-eight year old white male in whom tuberculosis of the dorsal spine developed in 1929. A spine fusion was done in that year. By 1931 a kyphus appeared which involved most of the dorsal spine and so another arthrodesis of the spine was performed.

The patient was well until October 7, 1947, when he noticed paresthesia in both lower extremities while walking. His lower limbs became progressively weaker and he was hospitalized three days later. By the seventeenth he was completely paralyzed from his waist down.

On October 21, 1947, a hemifusion from D12 to L2 was done using iliac chips. A superficial ulcer appeared at the upper pole of the wound and this persisted until December 31st. However, the patient improved generally and by January 7, 1948, he began to have return of function in his lower extremities.

On February 10th another hemifusion was done from D7 to D12 and the patient continued to show a return of lower limb function as well as bladder and bowel control. He was kept at complete bed rest and by December, 1948, his only residual was an inconstant bilateral ankle clonus.

X-rays at this time indicated a pseudarthrosis at the lower end of the fusion area. Consequently, on November 9th a third operation was performed. The gibbus area was found to

be solid but there was a definite pseudarthrosis between the bone graft at the level of L1 and L2. Again using iliac chips this pseudarthrosis was repaired and the fusion was extended up from D7 to D5 and down to L3. His convalescence was uneventful.

CASE VII. H. W., a twenty-three year old colored male, was a schizophrenic patient in a mental institution. In addition, he had tuberculous epididymitis. Because he lost 15 pounds in weight in the preceding five months he was given a thorough x-ray examination and a destructive lesion involving the bodies of C4 to C7 was discovered. On May 9, 1948, he complained of weakness of all four limbs and he was placed in a plaster of paris collar. On the fourteenth he was transferred to the Halloran V. A. Hospital in a febrile state. Examination revealed an 80 per cent loss of motor function of the left upper and a 60 per cent loss of the right upper extremity. His left lower limb was completely flaccid and his right showed 80 per cent loss of motor function. Sensation from the abdomen down was progressively diminished.

On May 25th the plaster collar was removed and Blackburn skull traction was applied. On June 3rd using iliac chips a left hemiarthrodesis was done from C2 to D1. Postoperatively, the patient was kept on a Stryker frame with skull traction maintained. Both the cervical and iliac wounds healed cleanly. By July 4th this patient was able to flex both knees slightly and on the twenty-fourth x-rays revealed early signs of fusion of the cervical spine.

Since admission his temperature ranged from 101°F. to 101.5°F. except for four days immediately after surgery when he had a fever of 102.4°F. On August 13th more than two months after the operation, the temperature began to rise to 102°F. and 103°F. and he became increasingly drowsy. He died on August 25, 1948, with a terminal temperature of 105.8°F. Autopsy revealed that tuberculous meningitis of the brain was the primary cause of death.

FEMORAL VENIPUNCTURE*

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FREQUENTLY, a necessary venipuncture becomes a difficult procedure because circumstances prevent or discourage the use of customary veins. Such occasions may arise with shock, severe burns, traumatic wounds of the extremities or thrombosis of veins due to repeated use and obesity. Sometimes, as in severe hemorrhagic shock, there can be no time wasted in restoring blood volume. Surgical isolation of a vein and use of the Lindeman needle[4] are often good in these emergencies. Femoral venipuncture, however, is a quicker and much simpler procedure. We have concluded from this investigation that femoral venipuncture is a safe, rapid and easy method for the immediate replenishment of body fluids.

* * * *

ANATOMIC FACTORS

Pertinent measurements were recorded from seventy femoral triangle dissections on thirty-five adult cadavers of both sexes. (Table 1.) Points of particular interest are the following:

Contrary to general impression the femoral artery does not lie midway between the anterosuperior spine and the pubic tubercle but lies medial to this point. Since the femoral vein lies medial to the artery, it is evident that it must be nearer to the pubic tubercle than to the anterosuperior spine.

In all instances except one the femoral artery and vein were found to lie side by side beneath the inguinal ligament. In one instance the vein was almost completely behind the artery at this point.

The average diameter of the femoral vein was found to be 1.3 cm.

The average distance from the inguinal ligament to the saphenofemoral junction was 5.3 cm. A needle inserted through the skin about 4 cm. below the inguinal ligament and directed upward at an angle of 60 degrees will pierce the femoral vein between the entrance of the great saphenous vein and the margin of the inguinal ligament.

TABLE 1
ANATOMIC MEASUREMENTS BASED ON SEVENTY FEMORAL TRIANGLE DISSECTIONS (THIRTY-FIVE CADAVERS)

Distance Measured	Greatest Measurement (cm.)	Smallest Measurement (cm.)	Average of 70 Dissections (cm.)
Anterosuperior spine to center of femoral artery	8.5	5.0	6.5
Pubic tubercle to center of femoral artery	6.2	3.0	5.0
Diameter of common femoral vein	2.0	0.5	1.3
Inguinal ligament to sapheno-femoral junction	7.0	3.0	5.3
Inguinal ligament to point at which femoral vein starts to pass behind femoral artery	11.0	0.0	6.6
Inguinal ligament to terminal of deep femoral vein	12.0	4.5	7.9

Near the apex of the femoral triangle the vein, which lies beside the artery under the inguinal ligament, gradually disappears behind the artery. The average distance from the inguinal ligament to where the vein starts to pass behind the artery was found to be 6.6 cm. In only three instances was this measurement less than 4 cm. Therefore, a femoral venipuncture directed just medial to the pulsating femoral artery would normally strike the femoral vein if inserted within 4 cm. below the inguinal ligament.

Edwards and Robuck[2] found the deep

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femoral vein terminated at an average of 8 cm. from the inguinal ligament and in no instance at less than 5 cm. In our cases the average was 7.9 cm. with 4.5 cm. the smallest distance.

The possibility of anomalies must be considered. The only anomaly we encountered was the passage of the vein almost completely behind the artery under the inguinal ligament. Other possible anomalies are doubling of the femoral vein, the presence of only a rudimentary femoral vein and an anterior position of the vein in relation to the artery. In a series of 250 subjects Hovelacque[3] reported four instances in which the vein was lateral to the artery. This finding was not substantiated by Edwards and Robuck nor by us. In 100 successive femoral venipunctures on living patients we had no difficulty in striking the vein just medial to the artery.

TABLE II
ANATOMIC MEASUREMENTS BASED ON 100 FEMORAL VENIPUNCTURES ON 100 PATIENTS

Distance Measured	Greatest Measurement (cm.)	Smallest Measurement (cm.)	Average of 100 Cases (cm.)
Anterosuperior spine to femoral artery pulsation	9.5	6.5	7.8
Pubic tubercle to femoral artery pulsation	6.2	3.0	4.1
Skin surface to femoral vein with needle directed upward at 60° from a point 4 cm. below the inguinal ligament	5.0	1.8	3.7

CLINICAL USE AND TECHNIC

One hundred femoral venipunctures were performed on 100 adult patients with the determination of necessary measurements and the tabulation of complications. (Table II.) In all cases the actual depth of the needle from skin surface to femoral vein was recorded. The findings were relatively constant for certain body types. The depth of the femoral vein in individuals of medium build was 3.0 to 4.5 cm., whereas in those of heavy build it was from 4.5 to 5.5 cm. The average depth of all 100 cases was 3.7 cm. Sex was not a contributing factor. In the more debilitated persons the femoral vein was found to lie within 2 cm. of the skin surface. The measurements from the anterosuperior spine and the pubic tubercle to the femoral artery support the previous figures obtained from cadavers, namely, that the femoral artery lies much closer to the pubic tubercle than to the anterosuperior spine.

An additional use of femoral venipuncture is in the determination of total blood volume by the Evans blue dye method which we have previously reported.[1] In patients on whom an accurate puncture of an antecubital vein cannot be performed use of the femoral veins is indicated and more accurate.

The technics utilized in femoral venipuncture are the following:

First, clean the femoral area with a suitable antiseptic agent. It may be advisable to shave the area first.

Second, palpate the anterosuperior spine and the pubic tubercle. Estimate the probable position of the femoral artery, normally 3 to 5 cm. from the pubic tubercle. Palpate the margin of the inguinal ligament and immediately inferior to the ligament feel for the femoral artery pulsation. When this is found, a point 4 cm. distal to the ligament in the long axis of the thigh marks the desired vertical measurement. The vein will then be 0.5 to 1.0 cm. medial to the artery.

Third, use a syringe with a No. 17 to No. 19 gauge needle of at least 5 cm. in length and enter the skin at the point previously determined over the femoral vein. Direct the needle upward at an angle of 60 degrees from the skin surface. A needle so directed will strike the femoral vein about 2 to 3 cm. below the inguinal ligament. When the needle passes through the fossa ovalis, there will be little resistance until the wall of the vein is punctured since the cribriform fascia

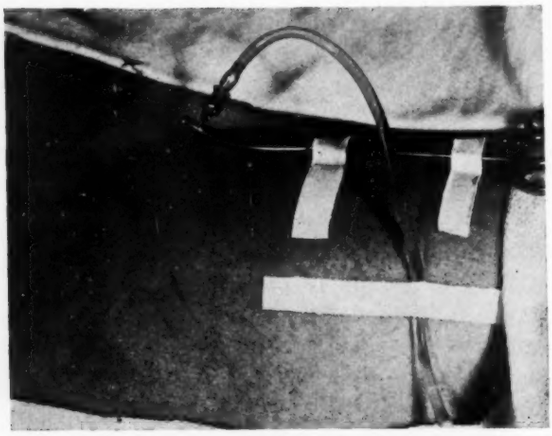

FIG. 1. Hemostat method for fixation of needle in femoral vein.

over the fossa ovalis is a relatively thin layer. However, if the falciform ligament is penetrated, there will be a definite point of resistance before striking the vein. For this reason it is necessary to withdraw the plunger of the syringe after any firm structure has been encountered. In severe vascular collapse it is easy to pass the needle all the way through the vein. In this case careful withdrawal accompanied by slight suction with the plunger will indicate the point at which the needle is in the lumen of the vein.

Fourth, fixation of the needle, which would seem to be a problem, actually is not. One method described in principle by Shaffer[7] consists simply of clamping the needle with a hemostat and fixing the hemostat to the thigh with adhesive tape. (Fig. 1.) The objection to this procedure is that most operating room and floor nurses do not seem particularly disposed to sacrificing a hemostat even momentarily. Other possibilities are the use of curved adapters or Stone's[8] method using a cardboard box.

Fifth, upon removal of the needle, pressure is applied directly over the site of puncture for several minutes.

COMPLICATIONS

A list of the possible complications include the following, namely injury to the femoral nerve, penetration of a viscus in the presence of an unrecognized femoral hernia, hematoma, abscess or cellulitis, penetration of a psoas abscess, local ecchymosis, thrombophlebitis, phlebothrombosis and arteriovenous fistula. We observed none of these except one instance of local ecchymosis and one case of hematoma from donor blood. Autopsy examinations of eight patients with femoral veins punctured five to 120 hours before death revealed, in the early cases, only a slight tract of blood along the course of the needle with a slight reddened area on the vein; in the later cases no evidence of previous vein puncture existed.

Schneierson and Blum[6] have shown that no gross or microscopic abnormalities exist in the femoral arteries of dogs examined six, twenty-eight and forty-two days after femoral intra-arterial infusions.

Penetration of the femoral artery is not a serious error since withdrawal of the needle and application of pressure for a few minutes will result in adequate hemostasis. According to a recent article by Robertson, et al.,[5] there are indications for intra-arterial transfusion. We have used the femoral artery for transfusion with good results.

We believe the ability to perform a femoral venipuncture is a practical asset to any physician, particularly one who is a member of a house staff.

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CARCINOMA OF THE BREAST

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THE purpose of this review is to make a critical study of carcinoma of the breast treated primarily with surgery at the Methodist Hospital from 1932 to 1941. One hundred sixty cases were reviewed. In 112 of these cases a five-year follow-up was obtained. Only these cases will be considered. Forty-eight patients were not included because they were not treated primarily with surgery or there was no follow-up obtained. Of the 112 patients twenty-seven lived five years without recurrence, ten lived five years but had recurrence and seventy-five died within five years.

Table I

	Survived Five Years	Survived Five Years with Recurrence	Dead in Five Years
Past menopause	4	11	32
Still menstruating	3	3	20
Sterilized by x-ray	0	3	2

* * * *

The average age was fifty-two years. The total number of patients under forty-five years of age was thirty-two; total number between forty-five and fifty-five years of age was thirty-three and total number over fifty-five years of age was forty-seven. These figures do not show any particular trend of increased carcinoma of the breast in the menopausal years.

The problem of hormonal stimulation is brought up time and again in this discussion. No hormones were used in this series. The menstrual histories recorded give figures as shown in Table I.

Calling attention to physical signs is important from the prognostic standpoint. A careful breakdown of physical signs will be presented. Some occurred singly or more than two physical signs may have appeared in the same breast. Table II shows the prognostic significance of physical signs.

Table II

	Survived Five Years	Survived Five Years with Recurrence	Dead in Five Years
Tumor attached to skin	9	5	18
Tumor attached to skin and deeper structures	1	2	20
Retraction of nipple	5	6	29
Ulceration	1	0	2
Discharge from nipple	2	0	13
Dimpling of skin	6	2	27
Simple tumor	10	1	14

Duration of symptoms and presence of axillary metastases affect the prognosis also. By coincidence several of the histories reviewed showed symptoms existing for five months or more, and arbitrarily five months was chosen to express duration of symptoms in Table III.

Patients discovered their tumors in all but ten cases. Women should be educated to feel their breasts for tumors and then consult their physicians for advice when masses are found.

The presence of axillary metastases gives a poor outlook as is shown in Table III.

There was a total of sixty-eight of 112 cases in which axillary metastases were present. The axillary nodes are sometimes phantom and clinically difficult to make

out. In forty-one of sixty-eight cases having metastasis the axillary glands were not palpated preoperatively but were present pathologically. Only twenty-seven of the sixty-eight cases showed preoperative presence of axillary nodes which were proven

TABLE III

	Survived Five Years	Survived Five Years with Recurrence	Dead in Five Years
History of tumor for five months.....	7 of 27	5 of 10	32 of 75
Axillary metastasis...	6 of 27	3 of 10	59 of 75

pathologically. There were also nine additional cases in which axillary nodes were palpated and considered pathologic but were not proven to be invaded by tumor at the time of pathologic section.

The surgical treatments used were radical mastectomy, radical mastectomy leaving in the pectoralis minor, simple mastectomy, simple mastectomy and cleaning the axilla and, in a few, simple excision of the tumor. Table IV summarizes these procedures.

TABLE IV

	Survived Five Years	Survived Five Years with Recurrence	Dead in Five Years
Radical mastectomy..	20	8	56
Radical mastectomy leaving in pectoralis minor.....	2	1	7
Simple mastectomy cleaning the axilla..	2	0	6
Simple mastectomy...	3	1	7
Excision of tumor....	1	0	2
Postoperative x-ray...	5	1	33
Preoperative x-ray....	3	2	0

The average length of life of the patient treated with radical mastectomy and postoperative x-ray in the group that died within five years was two years following the operation; whereas, the average length of life for all other procedures in this group, without or with x-ray was but one year. Table IV summarizes the use of x-ray therapy.

The survival group of patients with metastasis who lived at least five years is a very interesting one and will be reviewed in detail. In this group eight radical mastectomies were performed, one radical operation leaving in the pectoralis minor and one simple mastectomy. Of the eight patients who had radical mastectomies the first patient lived for seven years without recurrence and then supraclavicular nodes developed and the patient expired. The second patient had preoperative x-ray therapy and died seven years later of generalized metastasis. The third patient survived fifteen years without recurrence and then an axillary node developed which was removed and proved malignant. A course of x-ray therapy was introduced. No further follow-up was available.

In the fourth patient a recurrence in the scar developed four years postoperatively which was treated with x-ray therapy. Five years later a recurrence in the scar developed again which was re-treated with x-ray therapy. Two years after the second recurrence supraclavicular nodes developed and once again roentgen therapy was used. The patient lived one more year and then died of generalized metastasis. Her total life span was twelve years, eight of them after the first recurrence.

The fifth patient was a woman who lived ten years and then a recurrence in the scar developed which was treated with x-ray therapy. No further follow-up was available.

In the sixth patient metastasis to the femur developed four years postoperatively. She was treated with x-ray therapy and lived three additional years before dying of generalized metastasis.

The seventh patient had a radical mastectomy followed by a course of postoperative x-ray therapy. She lived six years and died of generalized metastasis.

The eighth case is the most interesting. Four years after radical mastectomy alone recurrence in the chest wall developed for which a radium jacket was applied. One year after the first recurrence in the chest the patient had a pleural effusion and again radium therapy was used. During this same year a peritoneal metastasis proven by laparotomy developed in the patient. This was treated with a course of x-ray therapy. After the last episode the patient lived one more year. Her total life span was six years.

The one patient who had radical mastectomy without removing the pectoralis minor received a course of postoperative x-ray therapy and lived eight years before dying of generalized metastasis.

Simple mastectomy was performed upon one patient. A skin recurrence developed eleven years postoperatively. A course of x-ray therapy was given and the patient lived for two years before dying of generalized metastasis.

The series of survivals with metastasis brings out two well known facts that are worthy of recapitulation. First, the patient who is apparently salvaged, even for a total of fifteen years, may still have recurrence at this late date; second, when these recurrences occur, they may be amenable to roentgen therapy even though they are extensive and will increase the life span of the patient.

There were three operative deaths, a mortality rate of 2½ per cent. The first was a fifty-four year old patient who died within two days after radical mastectomy. Postmortem examination showed there were metastases in the lungs, right adrenal, myocardial degeneration, and pulmonary congestion and edema. The second patient was sixty years of age and died suddenly on the eleventh postoperative day following radical mastectomy. Postmortem examination showed a mediastinal abscess, pulmonary emboli, congestion, focal necrosis of the liver and arteriosclerosis. The third patient was a forty-six year old Italian female, who died of apparent shock two and one-half hours postoperatively. There was no undue bleeding at the time of operation, and the operative time was one and one-half hours. The pathologic diagnosis was alveolar carcinoma with axillary metastases. No postmortem examination was permitted. Of these three operative deaths the first was inoperable from the start and the other two were definitely attributable to operation.

In this group of 112 cases, radical mastectomy was performed eighty-four times. The operation as practiced at the Methodist Hospital consists of an elliptical incision around the breast, after the manner of Halstead or Stewart, removing the breast, pectoralis minor and major, cleaning the chest wall and subcutaneous fascia, and the axilla. At no time in this series was more skin removed than would allow the wound to be sutured at operation. Of particular interest is the evidence of local recurrence in the skin which was noted in the follow-up eleven times. This does not compare unfavorably with results obtained in other institutions in which more extensive removal of the skin is practiced.

There were four cases of carcinoma of both breasts encountered in preparing this paper. These are briefly reviewed.

The first was a fifty year old patient who on routine physical examination was found to have a mass in the left breast which was hard, attached to the skin and retracted the nipple. A radical mastectomy was performed. The pathologic diagnosis was alveolar duct carcinoma with no axillary metastasis. A course of x-ray therapy was given postoperatively. Six months after the first amputation a recurrence occurred in the skin; this was excised. Eight months after the first mastectomy a firm tumor attached to the skin was discovered in the right breast. Again a radical mastectomy was performed. The pathologic diagnosis was schirrhous carcinoma with axillary metastasis. Roentgen therapy was given. The patient died four months later with metastasis to the lungs.

The second was a sixty-one year old patient who had noticed a lump in her left breast of five months' duration. It was hard, attached to the skin and retracted the nipple. A radical mastectomy was performed. The pathologic diagnosis was schirrhous carcinoma with axillary metastasis. Four years postoperatively the patient noticed a lump in the right breast. The tumor was firm and irregular. A radical amputation was done. Pathologic diagnosis was schirrhous carcinoma with metastasis to the axilla. The patient died in the same year with metastasis to the bones and lungs.

The third was a fifty-eight year old patient with a tumor mass in the right breast of two months' duration. It was firm and irregular. A radical mastectomy was performed. The pathologic diagnosis was duct-cell carcinoma with axillary metastasis. A course of postoperative x-ray therapy was given. Two years later her physician noted a tumor in the left breast. Once again a radical mastectomy was performed. The pathologic diagnosis was duct-cell carcinoma with axillary metastasis. A course of x-ray therapy was given. The patient died within the year of distant metastasis.

The fourth was a forty-seven year old patient with a tumor of the right breast of two months' duration. It was firm and not attached to the skin. No axillary metastasis was present. A radical mastectomy was performed. The pathologic diagnosis was alveolar carcinoma. A course of postoperative x-ray therapy was given. Two years after the first operation the patient noticed a tumor in the left breast and this breast was radically amputated. The pathologic diagnosis was duct-cell carcinoma with no axillary metastasis. Three years after the second mastectomy the patient was admitted with an acute abdomen. A laparotomy was done and a ruptured ovarian cyst removed. The patient died eight days postoperatively of a pulmonary embolus. The ovarian cyst was a papillary cystadenocarcinoma. Postmortem examination showed no evidence of metastasis. The case is rather singular in that the patient evidently had three different carcinomas over a period of five years, all in the female genital organs, and at the time of death there was no evidence of metastasis.

These cases present a medical problem. Even though one breast is treated and its disease apparently eradicated, the other can become a new source. A careful follow-up should be attempted with a watchful eye to the remaining breast as the possibility of a new focus.

Two cases of carcinoma in extramammary tissue remain to be reviewed.

The first was a sixty-five year old woman with a mass high in the right axillary line. It was hard but mobile. As soon as the patient discovered it she sought advice. On physical examination no mass could be made out in the breast. The tumor was removed locally and because the surgeon believed he was dealing with supermammary breast tissue went no further. The pathologic diagnosis was metastatic duct-cell carcinoma of the breast. A course of x-ray therapy was given and the patient was well with no recurrence seven years later.

The second patient was a fifty-six year old woman who had a tumor, not in the right breast itself, but just to the left and below it. This was believed to be extramammary breast tissue and was excised locally leaving the breast. The pathologic diagnosis was schirrhous carcinoma. A course of x-ray therapy was given. The patient died two years later of metastasis to the liver and lungs. Both of these cases were deemed carcinoma of extramammary breast tissue and both were locally excised; one of the patients lived and the other died. The question arises, however, as to whether or not radical mastectomy should have been performed in both instances. Although there was apparently no mass by examination in the breast, cases are reported of masses found in the axilla which prove to be carcinoma and after removal of the

breast sections may show a small area which is the primary site.

SUMMARY

1. One hundred twelve cases of carcinoma of the breast were reviewed; seventy-five died within five years, twenty-seven lived five years or more without metastasis and ten lived five years or more but had metastasis.

2. Local physical signs were more advanced in the group which died within five years.

3. Axillary metastasis was more predominant in the group which died within five years.

4. Various operative procedures were used, namely, radical mastectomy, radical mastectomy but leaving the pectoralis minor, simple mastectomy cleaning the axilla, simple mastectomy and excision of the tumor alone.

5. In the group dying within five years radical mastectomy followed by postoperative x-ray gave a longer life span.

6. Cases in the group living five years but getting subsequent recurrence were reviewed in detail to show both the length of time that may elapse before recurrence and to show the value of palliative x-ray.

7. There were three operative deaths.

8. Radical mastectomy was performed eighty-four times. In these eighty-four recurrence in the skin and scar occurred eleven times.

9. Four cases of carcinoma arising in the contralateral breast after the first breast was amputated for carcinoma were reviewed.

10. Two additional cases of extramammary breast carcinoma were reviewed.

EVALUATION OF RESULTS FROM CERVICAL DISC SURGERY

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AN evaluation of cervical disc surgery will be made herein. The syndrome of the protruded intervertebral cervical disc will be discussed and the diagnosis and treatment outlined. The differentiation between soft, large, protruded cervical discs and calcified, protruded discs will be made and the results of surgical treatment of each outlined. Thirty-three cases of surgically treated cervical discs will be analyzed. There have been thirty patients gaining complete relief from their symptoms following surgery and there have been three patients who have not gained complete relief from their surgery.

It is believed that an operation which offers 92 per cent opportunity for complete relief of the pain subsequent to the presence of a protruded intervertebral cervical disc, with no mortality or morbidity, should be regarded as one of value.

* * * *

The increasing frequency of cervical disc surgery for relief of protruding cervical discs prompts an evaluation of the efficacy of such surgery. Many large series of protruded lumbar discs have been analyzed as to their results following surgery, but this has not been done in a series of protruded cervical discs. The author's limited experience reveals that a protruded cervical disc may be found in the proportion of one to eight as compared to protruded lumbar discs. This, however, constitutes still a relatively large figure. Spurling's original report[1] of seventeen such cases made the general statement that the results have been excellent. Beyond this there has been no attempt at an exact delineation of the result that can be expected following removal of the disc.

Spurling, Murphey[2] and others[3,4] have presented the syndrome of the protruded cervical disc clearly and accurately. There is a history of trauma to the neck followed by local pain, which may be recurrent, and accompanied with pain which radiates down the arm into the index or middle finger or the thumb. Spurling also pointed out that most herniated discs are found at either C_5 and 6 or C6 and 7, and he described the anesthesia of the skin segment innervated by the nerve root of C6 which encompasses the dorsum of the hand at the base of the thumb. The nerve root of C_7, when impinged upon between C6 and 7, causes anesthesia of the dorsum of the index finger. The radial nerve is tender and the pain is reproduced by Spurling's maneuver which consists of compression of the head upon the trunk, with inclination of the head toward the affected side. The tricep reflex is diminished, in the author's experience, in both cases. He has not seen a diminished bicep reflex although Spurling describes it as diminished when the disc occurs between C_5 and 6.

Spinal puncture may reveal an increase in spinal fluid protein, and radiopaque material may reveal a space-occupying lesion of the spinal canal. These results, however, are so variable that the author would rather rely on his clinical impression. Roentgenographic examination of the cervical spine, however, gives some real help in that the presence of an osteophyte in the oblique views partially occluding the intervertebral foramen is considered diagnostic of the presence of a protruded intervertebral cervical disc at that level.

The differential diagnosis lies between that of a cervical disc and the more common causes of brachial neuritis such as bursitis of the shoulder joint with radiating pain. This can usually be ruled out by roentgenographic changes and local tender-

ness about the bursa. Tennis elbow occasionally may cause radiating pain, but the point of tenderness is not at the nerve. Angina pectoris or coronary vessel disease is occasionally diagnosed when actually the pain is due to the presence of a protruded cervical disc. Such a conflict in diagnosis, of course, is dangerous from both viewpoints. One would be reluctant to remove a protruded cervical disc in the presence of true coronary vessel disease. The neurologic findings, however, of a cervical disc are so clearcut that the diagnosis should seldom be confused.

The most common syndrome which is confused with that of a cervical protruded disc is that of anterior scalene spasm or aberrant cervical rib. Such a condition is distinguishable because of the vascular changes in the arm and the peripheral distribution of the pain as contrasted to the central distribution of pain manifested by a cervical disc. It should be remembered that the two conditions may be coincident or that the scalene spasm may be, and usually is, secondary to the cervical nerve root irritation caused by impingement upon the nerve roots innervating the scalene muscle.

The treatment of protruded intervertebral cervical disc has been so refined that it carries little hazard and little morbidity. The patient, following a hemilaminectomy and removal of the disc or decompression of the nerve root, usually is able to leave the hospital after six or seven days of hospitalization. He is able to return to his work within two to four more weeks. There has been no mortality in the author's series. There have been two instances in which pyramidal tract fibers have apparently been damaged but these symptoms have cleared up within three months. One such instance was the first cervical disc operated upon by the author, in which it was believed that the disc should be left *in situ* rather than be removed. This occurred in 1941 when a clear understanding of the situation was not available and the disc actually impinged upon the pyramidal fibers. The second instance followed the routine removal of a cervical disc, and there is no ready explanation for it. It is fortunate, however, that in both instances the pyramidal symptoms cleared rapidly. There have been no other complications following surgery.

The findings at surgery apparently do not influence the postoperative results although it is interesting to note that the large, pulpy, soft, ruptured cervical disc causes more extreme acute pain. The removal of such a disc has in every instance given complete relief of pain, with no recurrence to date. The hard, bony, calcified ridge, corresponding apparently to a calcified protruded intervertebral disc, has also given excellent results following surgery. The paresthesias in these cases, however, have persisted longer, up to three months. There has also been a postoperative period of discomfort which might be as long as three or four weeks. It is gratifying, then, to the surgeon to find a soft, pulpy protruded disc as contrasted to the hard ridge which entails more operative manipulation for its removal or decompression. It should also be noted that almost invariably in the presence of the calcified protruded disc a dilated epidural plexus of veins is found which is troublesome and which may, by its very presence, cause radicular pain. The presence of a soft, large, protruded disc apparently precludes the dilated plexus of veins and causes the removal of such a disc to be facilitated.

Thirty-three patients with protruded intervertebral cervical discs have been operated upon of 100 patients with cervical disc syndromes which have been studied. Of the thirty-three discs, six were of the soft, pulpy type, five of which were removed, and all of which gave complete relief of symptoms with no recurrence to date. The single soft disc which was not removed was the first disc of the series, done in 1941. Twenty-seven cervical discs were of the hard, calcified type presenting immediately beneath the affected nerve root and compressing the nerve root against the superior surface of the intervertebral foramen. Five of these hard, protruded, calcific ridges

have been removed with a small dental chisel, undercutting the nerve root. This removal has been accompanied by decompression of the intervertebral foramen by unroofing it. The combination, of course, necessitates more operative manipulation but has given complete relief in all cases. Twenty-two of the hard protruded cervical discs have not been removed but have been left *in situ* and the treatment has consisted merely of the unroofing of the intervertebral foramen accompanied, of course, by the hemilaminectomy necessary to expose the pathologic disorder. Of these twenty-two there has been complete relief of all symptoms, including any residual neck or arm pain, in all but three. These three patients have experienced mild to moderate residual neck or arm pain and must be considered failures although they spontaneously say that their pain has been much improved. There have been no patients who have had no relief following the surgical intervention and no patients whose symptoms have been made worse.

Of the three failures, in one patient an anterior scalene syndrome eventually developed; the pain was relieved completely by a subsequent scalenotomy. The other two still exhibit their mild, recurrent residual neck or arm pain. One patient who has been free from residual pain for two years had a long period of paresthesias of the arm and hand and mild tenderness about the neck. However, after four months her difficulty disappeared and at the present time she is classified as having had complete relief.

Two patients on the advice of qualified orthopedists underwent fusion following the removal of their hard calcified discs. This was done at the beginning of the series and has not been repeated, nor is it planned that it will be repeated in the future. However, both patients gained complete relief from their pain and have suffered no disability as a result of their fusion beyond moderate limitation of neck motion.

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BURNS—A SURGICAL PROBLEM

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IN the treatment of burns the application of iodine and acetic acid and the sealing of the burned surface with plaster of paris have proved quite successful. It is recommended that skin preparation be adequate and all burned parts of the body covered to prevent contamination. Pressure dressings should be used as a substitute for the skin thus helping to sustain capillary function. Any material may be used in contact with the burned surface (1) if not destructive by its removal from the burned area, (2) if it relieves and does not cause pain, (3) if it does not inhibit growth and repair of tissue and (4) if the dressing can be quickly applied, since speed is very necessary.

The method of treatment, developed over a ten-year period, using the concept of a burn as an open wound subject to infection, contraction deformities and delayed healing, is described herein.

* * * *

One hundred seventy-eight cases studied and collected since January, 1944, may be classified as to location and extent of burns (with some overlap) as follows: burns about the face, eyelids, ears, nose, lips, neck and scalp, forty patients, twenty-five hospitalized; burns about hands and arms, eighty-four patients, twenty-seven hospitalized; burns about legs and feet, fifty-four patients, twenty-three hospitalized and burns about chest and body, twenty-three patients, seventeen hospitalized. Of the 178 cases eighty-six may be classified as severely deep, the remaining ninety-two as moderately superficial burns.

The following routine of management gave the best results: (1) Rinse with normal salt solution to remove superficial mud, etc. (2) Shave hair in the case of scalds and chemical burns or burns in which hair has not been removed by flame. (3) Leave blisters unopened. (4) Apply 3 per cent tincture of iodine gently and wash with 3 per cent acetic acid (cider vinegar).

The iodine and acetic acid treatment is adapted from the management of ringworm of the scalp as described by Albert Strickler of Philadelphia. This combination prevents infection caused by fungus, pyocyaneus and other pyogenic bacteria from spreading beyond the skin borders.

It is well known that hands and feet of workers in super-heated atmospheres of foundries and steel mills are often infested with fungus and, also, that pyogenic bacteria invade skin broken by disease and injury. The inevitable appearance of green-colored pus on deep burns kept scrupulously guarded from external contamination is evidence of this fact.

To prevent infection that is latent in the skin of hands and feet from spreading to the burned area, we use iodine and acetic acid in all such areas and other parts where infection is likely to occur. The iodine preparation of the skin in dressings of burns has been used by us only in recent months and the results have been very gratifying. It is a logical procedure in any surgical operation or dressing.

Application of the solutions does not cause pain in initial or subsequent dressings. Charred skin is insensitive as is also the surface of blisters. If a blister is broken, the underlying edema renders it relatively painless in applying the iodine; moreover, iodine and acetic acid do not cause blood damage from absorption. Sulfa drugs, in our experience, will rapidly produce blood changes if used extensively. Sometimes sulfanilamide powder may be used over any area showing infection but this is seldom necessary. A more physiologic environment

FIG. 1. Plaster of paris wet in saline solution applied to skin and mucous membrane.

may be furnished by the application of dried red blood cells over granulating areas following burns while waiting for epithelization from deeper skin elements or for surface protection of new or old skin while preparing for skin grafts in third degree burns. Few second degree burns have required skin grafting because absence of secondary infection prevented a vast amount of deep tissue destruction that occurs in many severely infected wounds.

We have searched for an explanation of the clinical observation that iodine acted upon by vinegar becomes useful and not destructive. Competent chemists offer the theory that it is probably due to the presence of colloids and not to inorganic chemical reactions. We were unable to find any reference in medical or chemical literature to the use of iodine and vinegar in the treatment of wounds. It has been 100 years since standard textbooks of therapeutics and medicine have ascribed to vinegar any special important therapeutic value.

Reference to the use of vinegar (acetic acid) in cases of burns can be found in the writings of Dunglison,[1] Stille[7] and Pare.[6]

According to Goodman and Gilman[3] iodine, in spite of the present wide trend toward the use of high priced products which have obtained popularity, has survived as an efficient antiseptic. They state that iodine has a germicidal action similar to chlorine, i.e., "It iodizes and oxidizes the chemically active elements of bacterial protoplasms." They quote Salle that iodine has low toxicity as determined by its effect on the growth of embryonic tissue, and agree with Nye that the effect of iodine in its low toxicity to tissue is measured by the use of leukocytes as a laboratory standard. Both Nye and Salle found iodine high in germicidal action and low in tissue toxicity.

In burns of all types sealing the burned surface with appropriate strips of Specialists' Plaster of Paris dipped in normal saline gives adequate protection and does not inhibit the healing process. The following are important features of the plaster of paris dressing: (1) It can be applied very quickly. (2) Pain is rapidly relieved. (3) The calcium sulfate in the plaster, being slightly soluble in water[3] and combined with normal saline solution, furnishes a physiologic environment for unprotected living cells. (4) The wound is adequately sealed from contamination. (5) The dressing may be removed either by wetting with warm normal saline solution, or in the dry state without sticking to the raw surface and without causing pain or bleeding. (6) The use of a general anesthetic is eliminated because scrubbing of wounds or débridement of burns is not done.

The use of plaster of paris on burned surfaces makes possible a practical covering of face, nose, lips and ears as well as other body parts with pressure dressings. The plaster dressing prevents sliding over the dry skin. (Fig. 1.)

On large body burns a pad of dry or moist sterile gauze overlying the plaster of paris is covered with a sterile towel; then mechanics waste or sheet cotton wadding is applied. A pressure bandage of stockinet or ace band-

age avoiding constriction completes the dressing. The dressings are changed every forty-eight hours although since the use of iodine for skin sterilization it has been found safe to extend this period to four or five days. Face masks and aseptic technics are used when applying the dressing. It is more desirable to leave no part of the burned area uncovered.

A single strip of plaster for each finger (Fig. 1), lapping halfway on median and lateral surfaces with a small gauze pack between the fingers, is quickly applied and is easily removed. The plaster will remain on a lip wound twenty-four hours or more, if a strip is placed over the border of the lip, folded inside to the gum line and outside for an equal distance, and then troweled with a suitable instrument. Plaster moulded to the ear furnishes ideal protection. In burns of the face a gauze pack may be moistened in normal saline and placed over the entire head and neck, covering the plaster the same as in other parts of the body.

It is thus apparent that much valuable time is saved by this form of dressing. Treatment of shock based upon the modern concept of capillary physiology and fluid balance is of course important and calls for skillful management. The judicious use of penicillin, blood transfusions, maintenance of fluid balance, drugs for sedation and other appropriate measures will help to save life.

Our experience in this method of treatment of severe burns leads us to believe that maintenance of strict asepsis is always necessary and the technic does not call for any cutting operations whatsoever. Since the burn is the sole cause of shock, it should be treated promptly eliminating further pain or tissue damage.

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Case Reports

SYNDROME FOLLOWING GASTROILEOSTOMY*

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THE anastomosis of the ileum to the stomach in the belief that the jejunum is being anastomosed to it constitutes one of the rarest surgical errors. Careful search of the entire literature reveals only twenty-six previously reported cases. To this series we would like to add one additional case. It seems likely, however, that the number of cases done is greater than this, there apparently being a reluctance on the part of surgeons to report this surgical error.

The first case of a patient with gastroileostomy was reported by Martin[1] in 1915. In 1917 Mercur[2] reported a second case and referred to another said to have been operated upon by Judd in 1912. Klein[3] in 1926 mentioned a case in which the patient had been operated upon by Berg and in this case there was a gastroiliac ulcer, the first reported in the literature. Rivers and Wilbur[4] in 1932 reported six proved cases, one other patient diagnosed but not operated upon who was reported subsequently by Smith and Rivers after she had been operated upon, making seven cases, and also two cases of gastrojejunostomy with jejuno-ileostomy which have not been included in this series because there was no direct anastomosis between the stomach and ileum. In this series there were two iliac ulcers and one case of ileitis. Kogut[5] reported three cases in 1936. One of these had an iliac ulcer and one was a postmortem diagnosis in a man of sixty-three who had been operated upon a few days before for carcinoma of the stomach. Partial gastrectomy had been done and the ileum anastomosed to the stomach by mistake. Smith and Rivers[6] in 1943 reported eight cases in addition to the one previously reported but not proved by Rivers and Wilbur. This case was included in the Rivers-Wilbur series. In the Smith-Rivers series of eight cases there were three ulcers. Brown, Colvert and Brush[7] in 1947 reported three additional cases; one patient had an ulcer. This makes a total of twenty-five cases if we include the case referred to by Mercur.

An analysis of these cases shows a number of interesting facts. Fourteen were males; nine were females. The sex of the others was unreported. The ages of the patients varied from twenty-six to fifty-eight excluding the patient who was operated upon for carcinoma of the stomach at the age of sixty-three. Diagnosis of gastric or duodenal ulcer seemed fairly well established in most of the patients before their first operation but a reasonable doubt exists as to the presence of an ulcer in several. The length of time between the performance of a gastroileostomy and the reparative operation varied from three months to thirty years. When one considers the intensity of the symptoms in most of these patients, it seems remarkable that one patient could live thirty years and another twenty-three years with such an unphysiologic gastrointestinal tract. In such cases it seems likely that much of the food must pass through the pylorus and undergo reasonable digestion and absorption to maintain life and nutrition for such a long time; although cases, of course, have

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been reported in which virtually the entire small intestine has been removed surgically with recovery. The site of anastomosis of the ileum varied from 6 feet below the ligament of Trietz to 6 cm. above the cecum.

True pain was not common unless iliac ulcer was present. In the latter case it was usually in the epigastrium, back or lower abdomen. Discomfort of one type or another was not uncommon, however, consisting of fullness, cramping, etc. Diarrhea was the rule and in many cases it started immediately after the initial operation. In some cases it came on later, even a year or two later, and in several cases it was never present; in fact, constipation was troublesome in a few. Vomiting was common and in several cases fecal matter was vomited or obtained from the stomach on lavage, or there was belching of a gas with a definite fecal odor.

Weight loss was nearly always present and was usually profound, losses of 20 to 50 pounds being the common finding. Very few patients had no free hydrochloric in the stomach on gastric analysis. More often these readings were within normal limits for both free hydrochloric and total acid. Several cases had a hyperacidity. Only eight were diagnosed preoperatively with any certainty and two or three others were considered probably cases of gastroileostomy. Four patients were treated by partial gastric resection and all others, except the one which was diagnosed post mortem, were disconnected although seven of these had a gastroduodenostomy, a pyloroplasty or a gastrojejunostomy at the same or a subsequent stage. It is amazing that all of these patients who were operated upon survived in spite of the poor condition of many of them.

In most cases no statement was made about the presence or absence of anemia. When it was stated, in most instances the blood count was normal although in some a statement such as "a mild secondary anemia was present" was found. One case had a hemoglobin of 7.6 gm. In our case there was a macrocytic anemia.

We were interested in any statements regarding the stool but in most cases none were made. In one case the stools were said to be foamy and in one the fat was 33 per cent by dry weight. One had a "great excess of neutral fat in the stool" and tests of pancreatic function showed digestion of casein and starch to be deficient. This case was suspected of having a pancreatic deficiency. In one case it was stated that the stools were often lienteric. In some cases the definite statement was made that the stools contained no undigested fat. One case had fatty stools. One case interested us because it was said that there was a multiple neuritis, presumably from vitamin deficiency, with pains in the legs, stiffness, numbness, tingling and edema. Our case had considerable edema which we considered to be nutritional in origin.

CASE REPORT

J. A., white male, age seventy-two, was admitted to the Holy Cross Hospital on August 13, 1947, complaining of diarrhea, loss of weight and excessive appetite of two years' duration.

The patient had a long history of peptic ulcer and two years previous to this hospital admission had been operated upon elsewhere for obstructive ulcer with hemorrhage. Since the operation he has had diarrhea with four to seven watery bowel movements daily. There had been no blood or mucus in the stools. Diarrhea came especially when he lay down at night. He had grown progressively weaker and had lost 30 pounds in the past two years. He had an enormous appetite and felt hungry all the time. He was so weak that it was difficult for him to stand or get about. For the past several months he had noted swelling of the legs and ankles. This was better when he lay down.

He had been a miner for thirty years and had had chronic lead poisoning several years before.

Physical examination revealed an elderly, pale, white male who was evidently extremely weak and chronically ill. He weighed 129 pounds. His chest was emphysematous but there were no rales. His heart was normal in size and there were numerous extrasystoles. His abdomen was not distended and there was

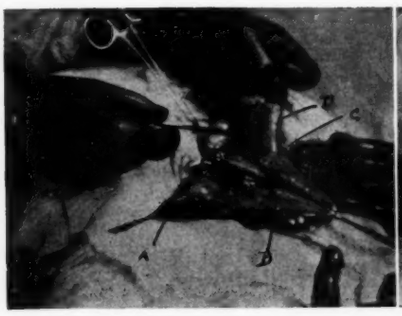

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FIG. 1. At operation; shows cecum (A), terminal ileum (B), gastroileostomy anastomosis (C) and stomach (D).
FIG. 2. At operation; shows dilated small bowel.

no tenderness, rigidity or palpable masses. There was 2 plus edema of the ankles.

His blood pressure was 100 over 70. Blood showed red blood cells, 3,750,000; white blood cells, 6,000; hemoglobin, 14.5 gm.; hematocrit, 45; mean corpuscular volume, 121; mean corpuscular hemoglobin, 38; mean corpuscular Hb. concentration, 32. Gastric analysis showed absence of free hydrochloric acid with histamine and total acid of thirty. Urine showed specific gravity of 1,020 with a trace of albumin. Stool examination showed increased neutral fat, a few meat fibers and indigested starch granules. Barium enema showed a normal filling of the colon with good caliber and normal haustrations.

Fluoroscopic examination of the stomach showed it to be normal in size and shape. After a few minutes' observation barium was seen to pass through an opening rather high up and pass directly into the cecum apparently about 10 inches distant. The barium also dispersed in the proximal loop. The diagnosis was a gastroileostomy about 10 inches from the cecum.

After entering the hospital the patient was prepared by two transfusions and an operation was performed August 18, 1947.

At operation the stomach was rather large and there was a large scar on the anterior wall of the duodenum just beyond the pylorus. The cecum was picked up and the terminal ileum identified and followed upward. About 6 to 8 inches above the iliocecal valve an anastomosis to the stomach was found. The rest of the small bowel, oddly enough, seemed dilated and edematous. No obstruction was found. The gastroileostomy was disconnected, a segment of ileum 3 inches long resected and an end-to-end anastomosis done. The opening in the stomach was closed. There was considerable free fluid in the abdomen. The patient stood the operation well although his general condition was only fair. Since discharge on August 20th the patient has gained 40 pounds. He eats well and has one formed stool daily. He has gained remarkably in strength and has no more ankle edema. (Figs. 1 and 2.)

COMMENT AND SUMMARY

Although only twenty-six previous cases of gastroileostomy have been reported in the medical literature besides the one reported here, it is likely that many unreported cases have occurred. It seems worth while to point out the existence of this surgical error with the hope that the incidence might be reduced in the future and also that the cases may be recognized and adequately treated.

The diagnosis is best made by x-ray examination of the gastrointestinal tract but the existence of this lesion may be strongly suggested by the appearance of diarrhea occurring soon after an operation in which the stomach is anastomosed to the bowel, namely, gastroenterostomy or gastric resection. The vomiting of fecal-like material is also suggestive after such surgery.

Prevention is, of course, the best treatment. This error can be best avoided by care in identifying the first loop of jejunum by first feeling and perhaps exposing the ligament of Treitz. This should be checked again before starting the actual anastomosis. On theoretical grounds gastric resection should be the best treatment

since the first operation has been done in most cases for peptic ulcer. However, many of these patients are poor surgical risks and in such cases merely disconnecting the anastomosis is the wisest procedure. If necessary, a gastric resection may be done later if there is a reactivation of the original ulcer.

The prognosis in the reported cases has been excellent in spite of the poor condition of many. Our patient is asymptomatic and in excellent general health six months after operation.

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J. Lederer, realizing that hyperthyroidism is more common in women, that the thyroid gland is intimately related to ovarian function and that hyperthyroidism often has its onset in puberty, pregnancy or menopause, decided to try estrone in the treatment of this condition. He uses large doses of this preparation in women having both hyperfunction of the thyroid and hypofunction of the ovaries. The four women he treated showed moderate to marked improvement, their weight increased and their basal metabolic rate, pulse rate and exophthalmos decreased. To a certain extent, therefore, and in selective cases, estrone may have value as an antithyroid preparation. (Of course, thiouracil and its derivatives are still superior as antithyroid drugs.) (*Richard A. Leonardo, M.D.*)

PERINEAL LIPOMA SIMULATING PERINEAL HERNIA*

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A LIPOMA presenting through the ischiorectal fossa offers various diagnostic problems in differentiating it from a perineal hernia of the ischiorectal type described by Krieg.[1] Perineal hernia is an exceedingly rare form of hernia and a tumor arising in the pelvis and, by extension into the perineum, simulating a perineal hernia is even more rare.[2]

In March, 1909, Mr. Lawrie McGavin showed at a meeting of the Clinical Section of the Royal Society of Medicine a woman aged thirty-six who had a swelling in the perineum appearing through the left ischiorectal fossa. This was diagnosed a perineal hernia owing to its easy and complete reduction and expansile impulse on coughing. Mr. McGavin reported the result of operation in this case the following month. A tumor had been found completely extraperitoneal and extending down to the left of the rectovaginal septum. The tumor was removed with difficulty and found to be continuous with the perineal swelling. Microscopic examination showed it to be a myxoma.[3]

Diagnosis of a perineal hernia is made upon the history of trauma or unusual physical effort followed by swelling in the perineum. The tumefaction may be tympanitic on percussion, imparts an impulse on coughing, is reducible and its course may be traced by palpation as the hernia is reduced.[4] Audible peristalsis in the mass may be an additional sign in arriving at a diagnosis of perineal hernia. The similarity between the accepted signs and symptoms of hernia and those presented in this case of perineal lipoma makes apparent the difficulty that may be experienced in differential diagnosis.

CASE REPORT

Mrs. A. G., a twenty-four year old white female, was admitted to the hospital on September 11, 1946, with a mass in the perineum which she first noticed in December, 1945, during the fifth month of her first pregnancy. She was delivered of a 7 pound, 11 ounce living child on March 30, 1946, after a normal labor and spontaneous delivery. The mass became larger following her pregnancy; it did not decrease in size at any time. The patient had had no pain, nausea or vomiting associated with the mass; her appetite had been excellent and bowel habits had been regular but she had noted blood in her stool on several occasions. No urinary symptoms had been noted. She had experienced sudden, sharp pain accompanied with cramps in the upper thighs, particularly the right, for four weeks before admission. The patient had had no serious illness or injury; an appendectomy had been performed in 1943.

The patient was well developed and well nourished but not obese. Her temperature, pulse and respirations were normal. Her blood pressure was 110/60. Examination of the head, neck, chest, abdomen and extremities was essentially normal. Rectal examination revealed a large, non-tender, irreducible mass presenting through the right ischiorectal fossa. (Figs. 1 and 2.) The skin over the mass was redundant, striated and dilated vessels were visible. (Figs. 3 and 4.) The mass was of doughy consistency and freely movable. Attempts to reduce the mass were not successful but a defect in the roof of the ischiorectal fossa which admitted two fingers could be easily felt through the mass. A cough impulse was present. Percussion note was dull and peristalsis was audible over this site. The mass could not be felt when the palpating finger was introduced into the rectum. The erythrocyte count was 3,900,000, hemoglobin 77 per cent and leukocytes 4,050. The urinalysis, blood sugar and urea nitrogen determinations were normal. The blood Kline reaction was negative.

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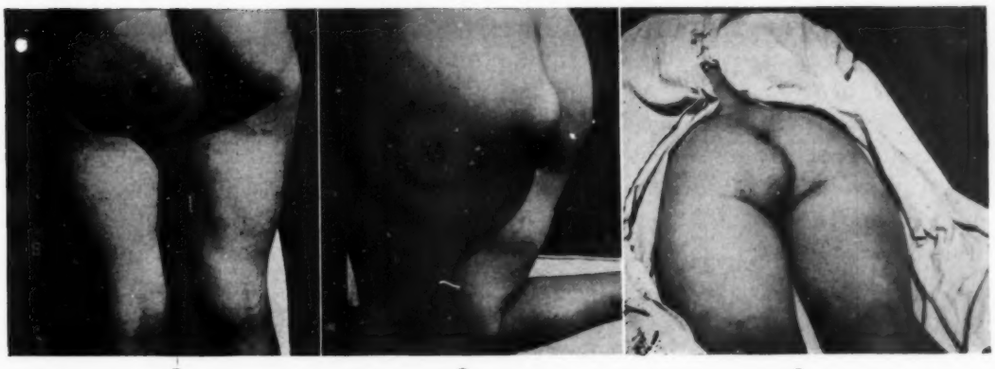

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FIGS. 1 and 2. Mass presenting through the right ischiorectal fossa; the patient is in a normal standing position without straining.
FIG. 3. Mass showing redundant, striated skin and dilated vessels.

FIG. 4. Same as Figure 3.

FIG. 5. This photograph represents the lipoma after removal from the pelvis.

A provisional diagnosis of posterior perineal hernia was made.

A roentgen study of the gastrointestinal tract with barium failed to reveal any portion of this tract protruding into the mass.

Operation was advised and on September 17, 1946, the abdomen was opened through a lower midline incision into the peritoneal cavity. No hernial opening was found in the peritoneal lining of the pelvis but a mass could be palpated to the right and anterior to the urinary bladder. The peritoneum was dissected away from the abdominal wall; the tumor mass was reached extraperitoneally. The bladder was freed from its anterior attachments. Dissection was continued through the fascial planes of the floor of the pelvis and through the right levator ani muscle. The tumor was freed from surrounding tissues by careful, blunt dissection and removed. The bed of the tumor and fascial layers were approximated; the urinary bladder was sutured in its normal position and a soft rubber drain was inserted extraperitoneally to the site of the tumor. The peritoneum, fascia and skin of the abdomen were closed in layers.

The postoperative course was uneventful and the drain was removed on the sixth postoperative day. The patient was discharged from the hospital on the tenth postoperative day. The pathologic study revealed a tumor 15 by 7 by 3 cm. in size surrounded by a thick capsule. (Fig. 5.) The tumor cut with resistance and the cut surface was pale yellow in color and was granular. Sections of the tumor showed it to be a lipoma.

COMMENTS

This article is the report of a case of perineal lipoma which simulated a posterior perineal hernia of the ischiorectal type which was operated upon successfully.

Preoperatively, it was believed that the mass which presented through the right ischiorectal fossa was a hernial sac containing omentum which had become adherent,

thus causing it to be irreducible. It was thought that the sac probably contained some portion of the intestinal tract at times because peristalsis had been heard on more than one occasion. The presence of a cough impulse and dullness on percussion helped to substantiate the diagnosis of posterior perineal hernia.

Postoperatively and in retrospect it would seem that the occurrence of the lipoma was coincidental with pregnancy and no direct relationship existed between the lipoma and the pregnancy. The occasional bloody stools and attacks of pain and cramps in the upper thighs can be explained by the presence of this space-taking lipoma in the bony pelvis, and as it became larger, causing compression of vessels and nerve pathways to the thighs. The cough impulse was present because of the descent of the lipoma when the intra-abdominal pressure was increased as the patient coughed. The peristalsis that was heard over the protruding mass must have been transmitted through the solid structure of the lipoma due to its position adjacent to the pelvic peritoneum in much the same manner that the whispered voice is clearly transmitted to the stethoscope through the consolidated lung of lobar pneumonia.

SUMMARY

An attempt has been made in this report to point out the similarity in physical signs that exists between posterior perineal hernia and perineal lipoma.

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ANTERIOR SACRAL MENINGOCELE*

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ANTERIOR sacral meningocele is not only an unusual lesion but one which may lead to death if aspirated through the rectum or vagina. These factors justify presentation of three patients seen in the clinic with a review of cases previously reported and discussion of the diagnostic problem involved.

Anterior sacral meningocele is a herniation of the caudal portion of the meninges and their contents through a defect in the anterior surface of the sacrum. Posterior herniation is not unusual but anterior meningocele is rare.

The meningocele sac filled with cerebrospinal fluid produces a cystic mass between the rectum and sacrum. The presence of such a mass may be apparent upon rectal or vaginal examination and it may or may not be symptomatic depending upon its size.

The mass may encroach upon the rectum, interfere with the fecal stream and produce constipation of varying severity. Numbness, tingling and pain may be present if the anterior sacral rami are involved in or compressed by the sac. Such parasthesia may be manifest in the third, fourth and fifth toes, the lateral portion of the leg in the distal third, the posterior portion of the leg, thigh and buttock, medial buttock and anal fold. In a woman if the mass is large enough, it may become an obstetrical problem because of pelvic obstruction.

Deformity of the sacrum has been present in twenty-three (68 per cent) of the thirty-four cases reported and in fifteen was demonstrated roentgenographically. In seven the sacral defect was palpated and in one demonstrated post mortem. In Case II only in which adequate roentgen examination was available was there no sacral defect. The roentgenographic appearance of the deformity is consistent enough to be considered characteristic; and when radiologists become familiar with it, there probably will be more non-symptomatic cases reported. (Fig. 1.)

The sacral deformity consists of a smooth oval defect in one side of the distal third with more or less deviation of the sacrum itself to the opposite side. At the lower margin of the defect the tip of the sacrum and coccyx hook under it. The appearance indicates that the sacrum has actually developed around a mass and the deformity varies with the position of the sac.

Schidler and Richards have reported a case in which lipiodol was introduced into the subarachnoid space by lumbar puncture and then demonstrated in the meningocele sac two weeks later.

Other tumors may occur in the hollow of the sacrum. Lipomas, hygromas, chordomas, gliomas and teratomas are uncommon but must be considered in the evaluation of a tumor mass in this area. Establishing a definite diagnosis by aspiration or excision may not be advisable if one profits by the experience of those who have attempted to do so. Although most of the reported patients were treated before the era of sulfonamides and antibiotics, the hazard of surgical maneuvers in this field cannot be reckoned lightly.

An analysis of the reported cases shows the high mortality associated with any form of surgical interference. Twenty-six of the thirty-four reported patients were subjected to some type of diagnostic or therapeutic surgical procedure. Meningitis developed in fifteen of those patients treated and in eleven cases this was fatal.

Approach to the problem has been var-

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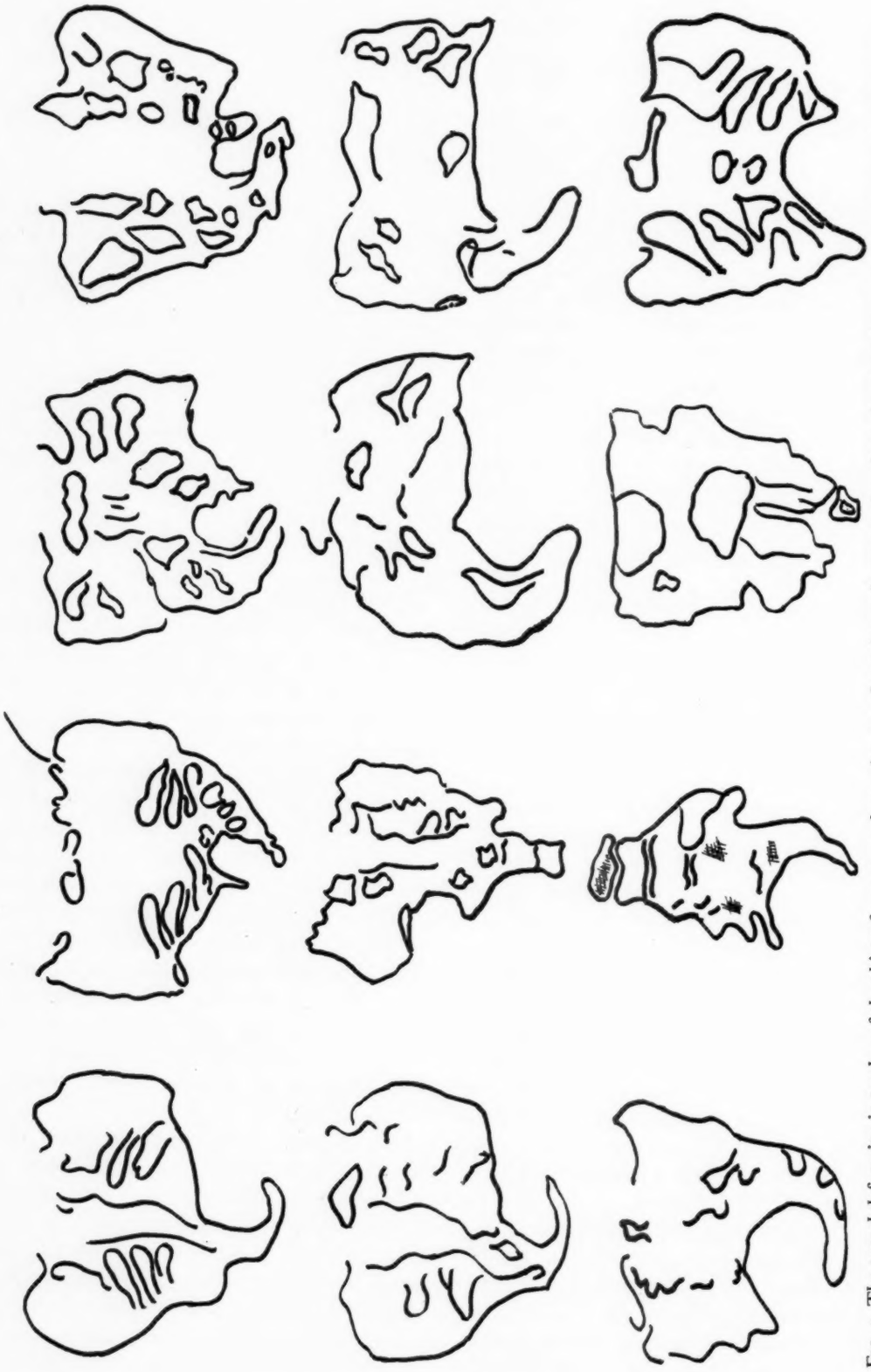

FIG. 1. The sacral deformity in twelve of the thirty-four cases of anterior sacral meningocele reported to date; drawings from roentgenograms of postmortem preparations. Top row, our Cases 1 and 11 and cases of Luth and Tulp; second row, Schidler and Richard's four cases; bottom row, cases of Coller and Jackson, Emmett, Kennedy and Adson.

ied. Any attempt at aspiration or excision through the rectum or vagina invariably resulted in meningitis and only two of the nine patients so treated survived the procedure. Seven patients underwent laparotomy with two resultant deaths. In ten patients the mass was approached through a dorsal incision in the sacrococcygeal area; in three of these meningitis developed, with two deaths.

Three deaths were reported in the eight untreated patients. Two of these were caused by puerperal sepsis after craniotomy attempted in term pregnancies complicated by the presence of a meningocele. One was in an infant following the excision of a posterior meningocele and autopsy revealed an anterior meningocele, also.

Further analysis of the cases reveals the preponderance of the lesion in females and the frequent presence of other congenital anomalies. Of the thirty-four patients reported in the literature twenty-six were females, four males and in four the sex was not given. Ten of the thirty-four patients had other congenital anomalies.

In the light of the accompanying statistics anterior sacral meningocele seems to fall into that category of lesions which are best treated with skillful neglect. A large meningocele discovered in the course of examination during pregnancy would warrant the consideration of cesarian section. In one of our patients it may be noted that a cesarean section had been performed because of fetal malposition whereas in another patient with a meningocele of similar size there was a history of three vaginal deliveries without unusual difficulty.

CASE REPORTS

CASE 1. Mrs. J. T., a fifty-five year old housewife, was seen at the clinic on August 1, 1944, complaining of an almost constant, low midline backache, nocturia and stress incontinence, all of many years' duration. She had been referred to us by her local physician for treatment of chronic endocervicitis.

Past history revealed dyspepsia and stubborn constipation for as long as she could remember. She had undergone three uneventful pregnancies.

FIG. 2. Deformity of the sacrum in Case 1.

Physical examination was not remarkable except for pelvic and rectal findings. Pelvic examination revealed a large cystocele and rectocele with second degree prolapse of the uterus. The cervix was lacerated and everted. On rectal examination a soft, fluctuant tumor mass about 5 cm. in diameter was palpated behind and to the left of the rectum evidently between the rectum and the sacrum.

Roentgenographic examination of the pelvis revealed deformity of the sacrum which was deviated slightly to the right in its lower third below which the tip and coccyx hooked sharply to the left as though having originally developed around a mass. (Fig. 2.)

Roentgen examination of the colon with a barium enema revealed no demonstrable connection between the colon and the retrorectal tumor.

On December 5 operation was performed under cyclopropane anesthesia. The patient was placed in prone position and the hips elevated. An incision was made in the sacrococcygeal area and the coccyx dissected free from the posterior aspect of the rectum. The coccyx was removed and the caudal portion of the tumor exposed. It appeared to be a smooth-walled cyst and changed in tension with respiration. At this point the probability of the tumor having a connection with the spinal canal was considered and aspiration revealed clear fluid which seemed to be spinal fluid. No excision was attempted. A lotus cloth drain was placed down to the sac and the wound closed.

The patient's recovery from this procedure was without incidence and six weeks later a

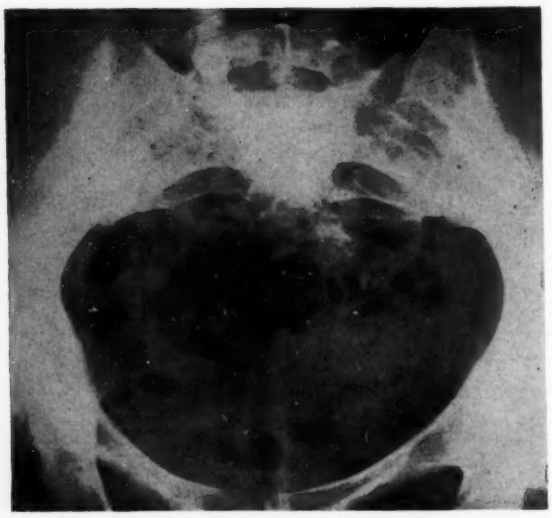

FIG. 3. Deformity of the sacrum in Case III.

Watkins-Wertheim interposition operation was performed to correct the uterine prolapse.

On subsequent visits the meningocele has been palpated through the rectum and apparently had not changed in size or tension. The patient has vague pain and headaches noted particularly on straining during bowel movement.

CASE II. Mrs. E. W., a thirty-two year old housewife, registered at the clinic on March 19, 1942. Her chief complaint was difficulty in swallowing. Nervousness, fatigue, insomnia and dyspepsia were present over many years.

Positive findings in the physical examination were erosion of the cervix, liver palpable just below the right costal margin and a soft, rounded mass felt on rectal examination behind and to the left of the rectum about 5 cm. from the anus. This seemed to be attached to adjacent structures and to the sacrum.

Neither barium enema nor proctoscopic examination could disclose a connection between the rectum and the tumor.

Following the experience with our first case in December, 1944, the possibility of an anterior sacral meningocele was considered in the present instance.

On a return visit a roentgenographic examination of the pelvis was within normal limits but it is the opinion of the authors that this lesion represents a meningocele.

CASE III. Mrs. J. B., a forty year old housewife, was first seen at the Clinic on February 5, 1948. She had had three full term pregnancies. The first was uneventful, the second had been terminated by cesarian section due to some type of fetal malposition and the third had not been remarkable.

Her complaints were chiefly vaginal discharge and weight loss. She had been constipated all her life and this constipation had been more severe in recent months. There had been a tendency towards missed periods although the vaginal discharge had been consistently blood-stained.

Physical examination revealed an underweight female with generalized tenderness on abdominal examination. Pelvic examination revealed an inflamed vaginal mucosa which yielded a positive smear for Trichomonas vaginalis, a uterus slightly enlarged and partially fixed on the right. Rectal examination disclosed a cystic, retrorectal spherical mass, 5 by 3 by 2 cm., fixed to the sacrum on the right side.

A diagnosis of anterior sacral meningocele was made and confirmed by roentgenographic examination of the pelvis which revealed a deformity of the sacrum consisting of a smooth, oval-shaped defect in the right margin with associated deviation of the lower portion of the sacrum towards the left. The appearance indicated that the sacrum had developed around a mass and that the deformity was congenial or had developed in childhood. (Fig. 3.)

Further work-up of the patient revealed cholelithiasis and evidence of duodenal ulcer.

An opportunity for an intra-abdominal evaluation of the tumor was presented at laparotomy on March 1, 1948. At this time a dilatation and curettage of the uterus, cholecystectomy and appendectomy were performed.

A right paramedial incision above the navel was made. The examining hand encountered the meningocele as a mass, 5 by 3 by 2 cm., encroaching upon the lower part of the pelvis. This was directly behind the rectum, pushing it forward. The sacral defect could not be felt because of the tightness of the sac.

The patient made an uneventful recovery following the operation and had few complaints at the first postoperative visit.

SUMMARY

Three cases of anterior sacral meningocele are reported. The lesion manifests itself as a palpable and cystic tumor mass between the rectum and sacrum and represents a herniation of the meninges through

a defect in the anterior plate of the sacrum. In 68 per cent of cases reported it has been associated with a characteristic deformity of the sacrum which may be recognized in roentgenograms. Surgical interference has resulted in high mortality due to postoperative meningitis. Thirty-four cases have been reported in the literature including the three cases in this study.

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TRAUMATIC ASPHYXIA

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WE have had occasion to see two patients displaying the century old syndrome of traumatic asphyxia, the case described herein being the more marked.

Impetus for reporting the case was provided by the realization that to those unfamiliar with the condition it presented a most startling picture.

The mechanism involved in producing this livid discoloration is, briefly, the production of a positive pressure within the chest as a result of compression and a resulting congestion of the venous system of the head and neck. The latter may well be dependent on the absence or inadequacy of functional valves in the innominate and internal jugular veins.

Sections taken from the involved skin and examined microscopically have usually shown no extravasation of blood into the tissues but instead the capillaries have been found to be greatly dilated. In keeping with this finding it can be observed that the skin blanches under pressure. Moreover, the discoloration clears quite rapidly without passing through the stages of color change which are ordinarily seen in subcutaneous extravasation of blood. The subconjunctival hemorrhage, however, is a true one, requires a much greater period of time to clear and does give the appearance of icterus in the late stages.

It has been the usual experience that those individuals who do not die immediately following the injury have a relatively good prognosis as far as traumatic asphyxia is concerned. Whether recovery occurs, and the length of time involved for recovery, is usually dependent upon associated fractures or other injuries.

CASE REPORT

An eight year old white school boy was admitted to the trauma service a short time after being caught beneath and run over by the wheel of a roadscraper, sustaining a crushing injury of the abdomen and thorax. He presented a picture of traumatic asphyxia (cyanosis) with a livid blue discoloration of his head and face down to the collar line on his neck. The soft tissues of his face, eyelids and submental region were tense with edema and the child complained of dysphagia. There were extensive, bilateral, wedge-shaped subconjunctival hemorrhages. He appeared exceedingly uncomfortable but respiration was not markedly impaired. He was placed in an oxygen tent but after twenty-four hours this was removed without noticeable change in the patient's condition. The facial discoloration began to clear rapidly and by the second day had taken on a blue-red appearance. (Fig. 1.) Nuchal rigidity was quite marked, with peripheral reflexes being normal. He complained consistently of pain in his back and in the region of both hips. There was no evident deformity and motion was not markedly impaired. On admission his pulse was 120, respirations 30 and his blood pressure was 80/55. His temperature became elevated to 101°F. the second day and then came to normal. The pulse varied up to 140 per minute, later leveling at 96 per minute and the blood pressure stabilized at 116/64. A marked hypochromic anemia existed which was corrected by transfusion.

Stereoscopic x-ray examination of the pelvis revealed three transverse fractures through the medial half of the inferior ramus of the left pubis. There was also a small avulsion at the lateral aspect of the right innominate. The ninth, tenth and eleventh ribs were fractured 1 cm. from their vertebral insertions. No hemothorax or pneumothorax was found.

The patient was followed closely and steadily improved in appearance. On the eleventh hospital day the parents signed the child's release and took him home. On this date there was still moderate nuchal rigidity, the facial discoloration had practically cleared, the subconjunctival hemorrhages were still evident and there was still some pain present in the regions of fracture.

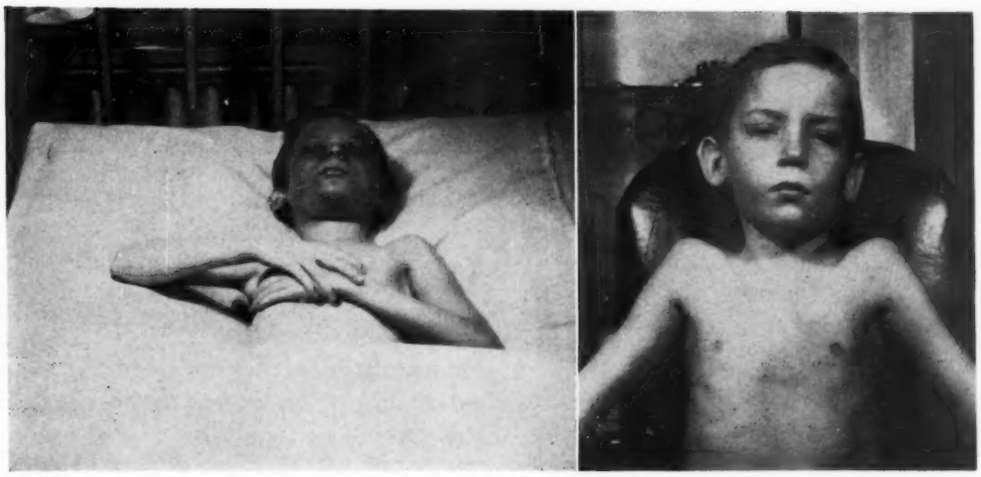

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FIG. 1. Appearance of child forty-eight hours following trauma; note discoloration and edema of face with line of demarcation on the neck.
FIG. 2. Eight weeks following trauma the child's face and scleras have normal appearance.

Eight weeks following trauma the child was re-examined. (Fig. 2.) All discoloration both of skin and scleras was cleared. He appeared normal in all respects except for minimal pain on walking. X-ray studies of the fracture sites revealed complete union of the rib fractures and considerable fading at the pelvic fractures.

SUMMARY

In the presentation of this case of traumatic asphyxia attention has been drawn to the fact that if death does not take place within a relatively short interval following trauma, prognosis for complete recovery is quite good. If the patient is seen immediately, high concentration of oxygen may be of great value but after the initial period treatment is directed toward associated injuries and the symptomatic care of the patient.

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New Instrument

A NEW TYPE OF T TUBE

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THE recent increase in common duct surgery has emphasized the inadequacy of the present type of T tube, some of whose disadvantages found existing are as follows: (1) There is a plugging of the upper end of the T tube by thick mucous and bile encrustations which resist dislodgement by irrigation. Attempts to overcome this by placing a small catheter in the upper lumen of the T tube have failed because the catheter itself offers obstruction to the free flow of bile and fluid, and a positive pressure is created when fluid is forced through the catheter. This fluid emerges from the tip of the catheter and, having no escape drain to empty into, is forced higher into the liver substance by pressure of the syringe behind, carrying infected bile and sediment with it. (2) When delayed cholangiography is performed, there is inadequate visualization of the hepatic ducts in cases of short circuiting operations between the common duct and gastrointestinal tract (e.g., choledochoduodenostomy). Here there is no sphincter of Oddi action at the common bile duct-duodenal junction as there is in the normal system and, therefore, any contrast medium injected into the T tube flows along the course of least resistance, i.e., via the lower limb of the T tube into the duodenum. Thus no visualization of the intrahepatic duct system is obtained. Rapid injection of the dye and positioning of the patient do not overcome this deficiency.

With these facts in mind the following type of T tube (Figs. 1 and 2) was devised:

A smaller, additional channel (X-Y) is incorporated within the T tube itself. This extra lumen lies in the upper limb facing the liver when placed in position at the operating table. The extra channel (X-Y) is 1/32 inch in diameter. This extra lumen is small and does not significantly add to the total width of the tube. The regular lumen (B-C) can be of any desired diameter while that of the additional channel usually remains constant. (Fig. 1.)

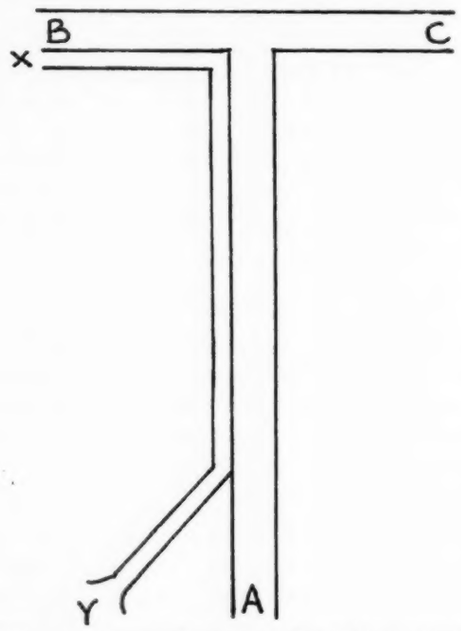

FIG. 1. B, upper limb of T tube; C, lower limb of T tube; A, long arm of T tube; X, upper end of extra lumen; Y, lower end of extra lumen.

ADVANTAGES

This double lumen T tube approaches the problems with which one is faced in the following way: It enables the surgeon to

FIG. 2. Actual photograph of the double lumen T tube.

FIG. 3. Cholangiogram taken in case of choledochoduodenostomy. The T tube is seen in position; the hepatic ducts are visualized. The obstructed common bile duct is to be noted.

irrigate the upper end of the common bile or hepatic duct directly without creating an obstruction to the free flow of bile through the regular lumen (B-C). (Fig. 1.) As the irrigating fluid emerges from the extra channel at (X), it causes no positive pressure driving sediment and mucus into liver since the large open end (B) of the regular lumen serves as a drain, immediately drawing off the dissolved, suspended and mechanically dislodged particles. In one case the double lumen T tube was left *in situ* for seven months. The tube was irrigated through the accessory lumen biweekly with sterile physiologic saline. When removed the tube was completely patent and showed no evidence of encrustations. By frequent irrigation one can therefore prevent the formation of crustations. In addition it is possible to liquify and dislodge existing thick mud and mucous collections at the upper end of the T tube safely and satisfactorily without interfering with the free flow of bile. Radio-opaque dye can now be introduced directly into the hepatic ducts with a syringe and, therefore, can considerably reduce the loss of the contrast media into the small intestines.

Figure 3 shows the cholangiogram taken fourteen days postoperatively in a case of common duct obstructions in which because of carcinoma of the head of the pancreas a choledochoduodenostomy was performed.

The patient was placed in a horizontal position and 15 cc. of diodrast were introduced with a syringe into the extra lumen using moderate pressure. Immediate anteroposterior and oblique views were taken. Good visualization of the upper common hepatic ducts and smaller hepatic branches will be noted. Comparative filling using a regular T tube is rare.

If the extra channel plugs up at (X) with biliary mud, it is easily and safely dislodged

because gentle *direct* pressure can be exerted against the obstruction using an irrigating syringe.

SUMMARY

A new type double lumen T tube is described and its advantages discussed. Superior cholangiograms are obtained in cases of short circuiting operations between the common duct and gastrointestinal tract than has been possible using a single lumen T tube. Prevention and dislodgement of obstructing encrustations in the lumen of the T tube are made possible without interfering with the free flow of bile.

Acknowledgment: The author wishes to express his appreciation to Dr. R. Franklin Carter and Dr. John Gazzola for their cooperation in the development and clinical use of this tube.

FOLLOWING the original technic of Dudgeon and Wrigley, several thoracic surgeons have lately attained a considerable amount of success in making a preoperative diagnosis of bronchiogenic carcinoma by carefully searching the sputum and bronchial secretions for carcinoma cells. These latter are usually larger in size and more variable in shape than normal cells; the nucleus is also abnormal, hyperchromatic and often contains large nucleoli. Of course, the histologic type of cell varies with the nature of the tumor present. In cases of squamous cell type of cancer or when the small "oat-cell" type of cancer is present, a definite cytologic diagnosis is possible. In other types of lung malignancy, be they primary or secondary, one can usually diagnose malignancy even though the pathologist cannot be sure of the exact histologic type of tumor. (*Richard A. Leonardo, M.D.*)

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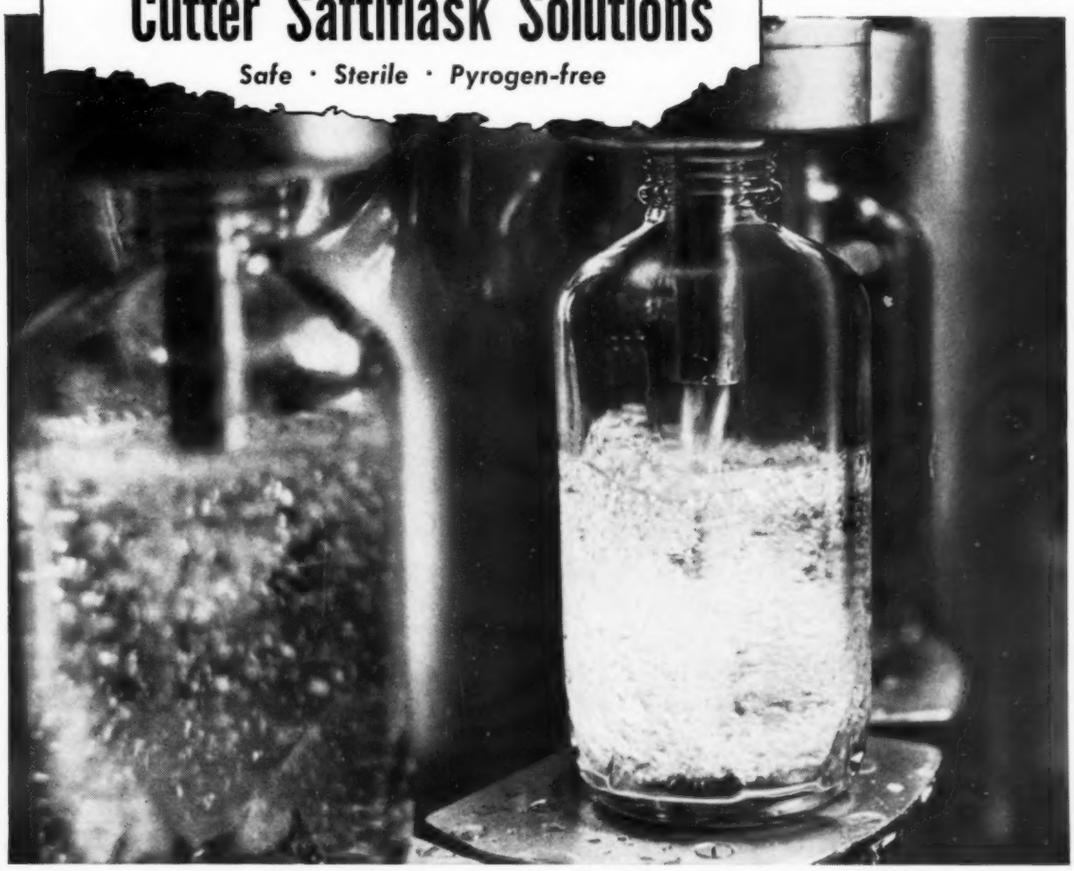

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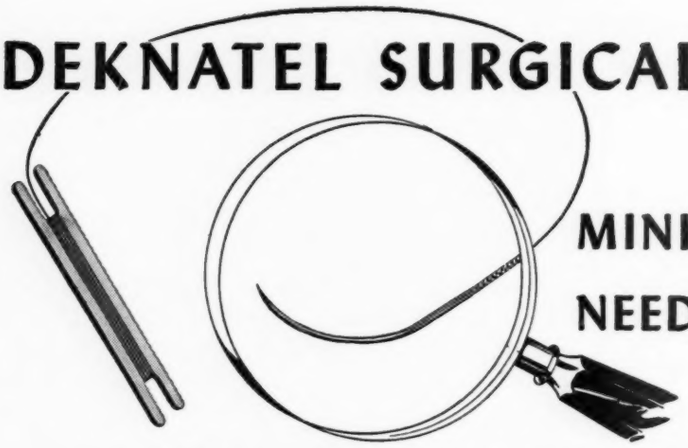

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Outside the Ivory Tower

(*continued from page 30*)

PROMINENT civilian medical men, including members of the Armed Forces Medical Advisory Committee, have messaged their approval of the current military hospital reduction program, the Department of Defense announced.

These nationally known physicians who express their endorsement of the program include, in addition to the members of the Advisory Committee, which advises the Secretary of Defense on broad policies affecting the military health services, medical advisers to the Veterans Administration and to the Surgeon Generals of the Army, Navy and Air Force, and a number who served on the Hoover Commission, Committee on Medical Services (Voorhees Committee) and the Committee on National Security Organization (Eberstadt).

DR. William Shive of the University of Texas, a leader in the chemical study of pernicious anemia who also has made important contributions to the understanding of human metabolism, received the $1,000 Eli Lilly & Company Award in Biological Chemistry on March 28th at the Houston Session of the American Chemical Society's 117th national meeting.

Dr. Shive is a member of the team of University of Texas researchers who recently reported the discovery and isolation of a substance called "apoerythein" which enables pernicious anemia victims to take vitamin B_{12} by mouth instead of by injection. The new compound permits the vitamin, which has proved highly effective in combating the disease, to be absorbed through the stomach.

ACCORDING to the Metropolitan Life Insurance Company about 3,700,000 babies were born in the United States in 1949.

It was the third year in succession in which the number of births exceeded 3½ millions, which is unprecedented in the country's history. The 1949 figure is virtually the same as for 1948 and only 5 per cent below the all-time peak reached in 1947. The accident toll in the United States for 1949 will total about 92,000 lives, a marked decline from the 98,000 killed in 1948.

This year's figure will be the lowest for any year of the past decade. In relation to population, the statisticians note, the mortality from accidents will be the lowest on record for the United States.

The tuberculosis death rate in the United States for 1949 is setting an all-time low record showing a reduction of about 10 per cent from the figure of the year before. The present rate in the population is only about a half that of twelve years ago.

"The gains against tuberculosis have been accelerated during the postwar years," the statisticians note. "And should the recent trend continue, the disease before long will be relegated to a minor position among the causes of illness and death in our country."

THE Army Medical Library has decided to bring the *Index-Catalogue* to a close. Following publication of the volume currently in preparation, the Library plans to publish a volume or volumes which will make the record of its monographic holdings complete up to the mid-century mark; and, beyond that, to publish selectively the most useful portion of the vast backlog of over 1,750,000 yet unpublished references which have accumulated over the years.

At the same time, the Library's Current List of Medical Literature will be augmented and improved in such a manner as to provide more effective service. An author index will be added; a standard list of journals to be covered regularly will be introduced; classification by broad journal groupings will be abandoned; the format and frequency of publication may be altered and a cumulative subject index will be provided.

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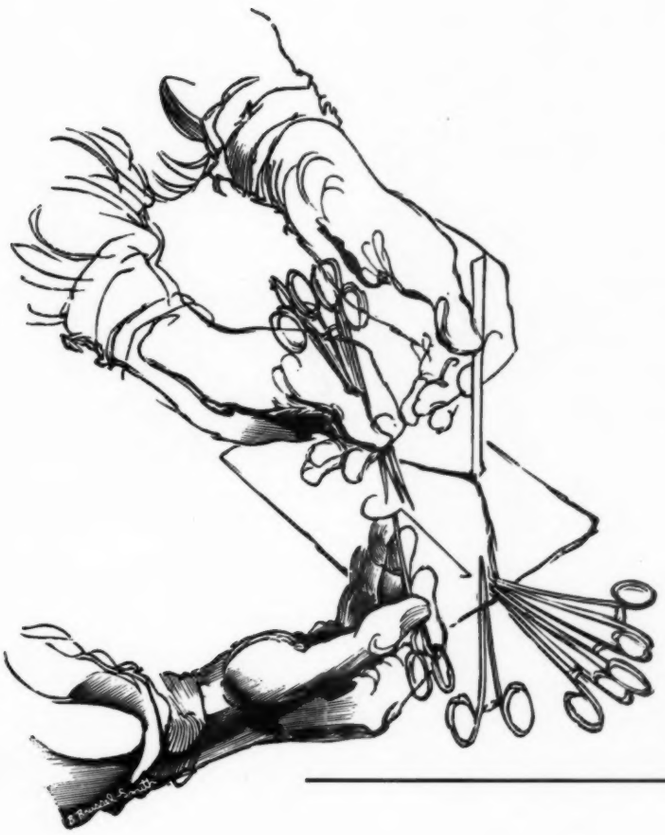

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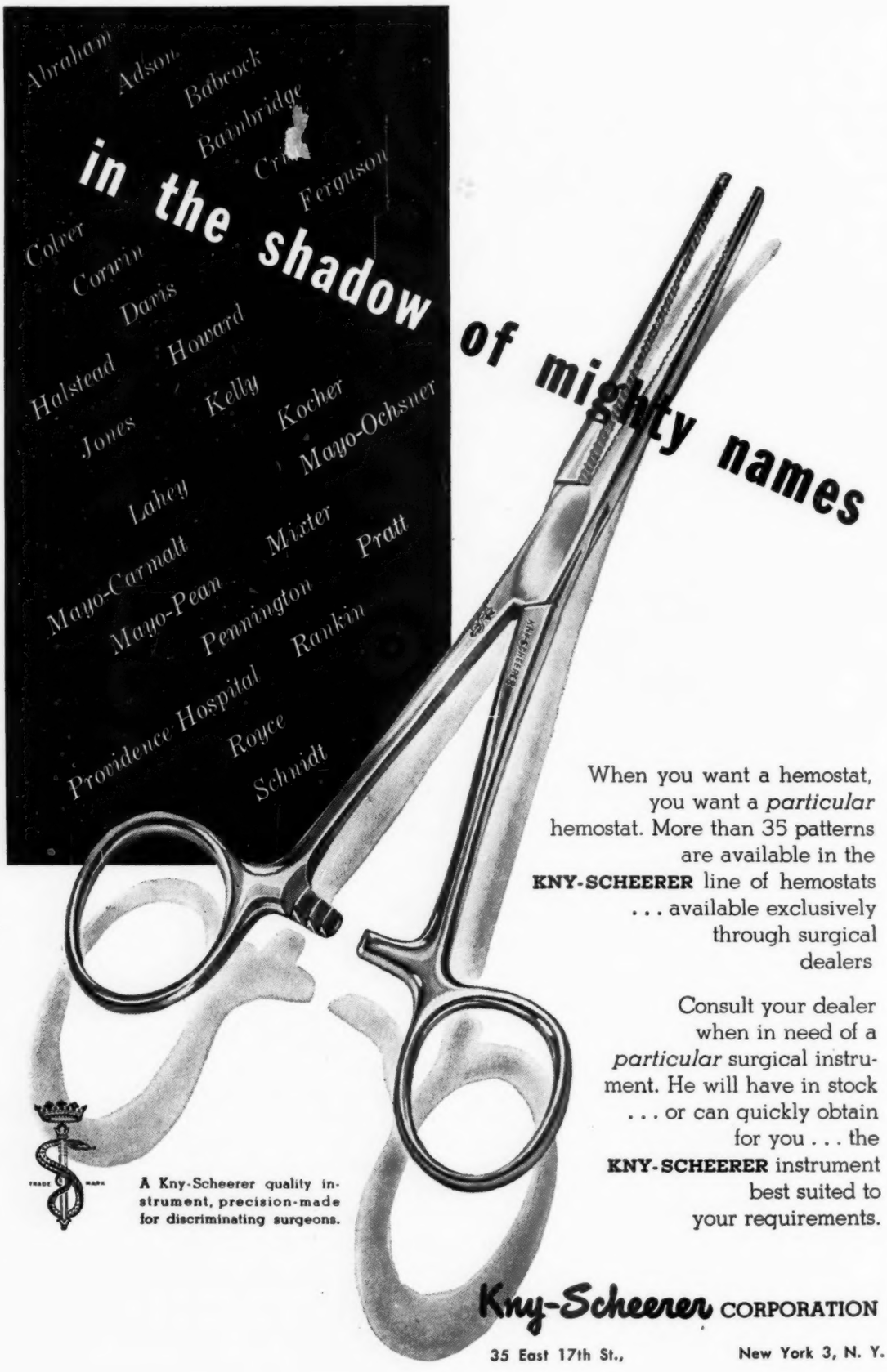

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1. Jorgenson, Graves & Savage: South. M. J., Sept. 1948
2. Schmitz, Towne & Baba: Am. J. Obst. & Gynec., 58:1, July 1949
3. Dorgan, McGanghey & Litton: Am. J. Surg., Aug. 1949

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